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SCIENCE

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CONTENTS

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THE PROBLEM OF RADIOACTIVE LEAD[1]

WE meet to-day with happiness which six months ago would have seemed beyond the bounds of reasonable hope. After anxious months, the confidently awaited victory, which last spring still seemed far away, has crowned the cause of justice, truth and liberty. We in America rejoice that this cause is our cause, and that at the most critical time we were able to render effective help to the staunch and brave allied forces which had fought so long and so nobly.

The object of this address is not, however, to appraise the military issues of the great war so fortunately ending, nor to deal with the weighty international problems now faced by the world, but rather to bring before you other considerations, having to do with the advancement of science.

The particular subject chosen, namely, the problem of radioactive lead, is one of peculiar and extraordinary interest, because it involves a readjustment and enlargement of many rather firmly fixed ideas concerning the chemical elements and their mutual relations, as well as the nature of atoms.

Within the last twenty years the definition of these two words, "elements" and "atoms," has been rendered somewhat uncertain, and bids fair to suffer even further change. Both of them are ancient words, and both even a century since had acquired meanings different from those of long ago. Thales thought of but one element, and Aristotle's elements—earth, air, fire, water and the quintessence, derived perhaps from yet more ancient philosophy—were not plentiful enough to account for all the manifold phenomena of nature. Democritus's old idea of the atom was asso-

[1] Address of the President of the American Association for the Advancement of Science, Baltimore, December, 1918.

ciated rather with the philosophical conception of indivisibility than with the idea of chemical combination in definite proportions. To-day many chemists and physicists think that the chemical atoms of the last century are no longer to be considered as indivisible. In that case, the old Greek name "atom" is no longer fitting, because it denotes indivisibility. Some one has even facetiously suggested that the word "tom"—indicating divisibility—would be more appropriate! Moreover, if our so-called atoms are really divisible, we can not but be somewhat doubtful as to our definition of the ultimate elements of the universe. The reason for this new turn of thought is due, as you all know, to the discovery of the unexpected and startling phenomena of radioactivity.

To-night we have to deal with a substance directly concerned with the iconoclastic radioactive changes—with the very phenomena which cause us to stop and think about our definitions of atoms and elements. For the lead obtained from radioactive minerals appears to have resulted, together with helium, from the radioactive decomposition of elements of higher atomic weight. Skeptical at first, the whole chemical world has now come to acknowledge that the well-defined element, helium (discovered by Sir William Ramsey twenty-three years ago), is one of the decomposition products of radium. Radium itself is a substance which, in many respects, acts as an element, with 226 as its atomic weight, and must be considered as the heaviest member of the well-known calcium family; but its atoms appear to be so big and so complex as to disintegrate because of lack of stability. The disintegration is slow, and not to be hastened or retarded by any agency known to man; 1,670 years are demanded for the decomposition of half of any given portion of radium, according to the exact measurements of Professors Boltwood and Ellen Gleditsch. Moreover, we have reason to believe that this decomposition proceeds in a series of stages, successive atoms of helium (five in all) being evolved with different degrees of ease by any given atom of radium. In the end most, indeed probably all, of the residual part of the radium appears to have been converted into the peculiar kind of metallic lead with which we are concerned to-night. The nature of the end-product was first suggested by Boltwood, who pointed out the invariable presence of lead in radium minerals. Thus we must accept a kind of limited transmutation of the elements, although not of the immediately profitable type sought by the ancient alchemists.

Interesting and significant as all of this is, nevertheless the whole story has not yet been told. Radium itself appears to come from the exceedingly slow decomposition of uranium, an inference drawn from the fact that radium is found only in conjunction with the uranium, which even after careful purification soon becomes radioactive and gives every indication of suffering slow disintegration. Moreover, uranium is not the only other heavy element which appears to be capable of decomposing and yielding elements of lower atomic weight. Another, thorium, has a like propensity, although the steps in this case are perhaps not so fully interpreted, nor so generally accepted. In the process of disintegration all these heavy atoms yield strange radiations, some of them akin to, or identical with X-rays, which bear away that part of the colossal energy of disintegration not made manifest as heat. These facts have been proved beyond doubt by the brilliant work of Madame Curie, Sir Ernest Rutherford, and others.

The nature of the rays, and of the highly interesting evanescent transition products and their relation to one another is too complex for discussion now. We are concerned rather with the nature of the more permanent of the substances concerned—especially with the starting point, uranium (possessing the heaviest of all atoms), radium, and the lead which seems to result from their disintegration. Omitting the less stable transition products, the most essential outcomes are roughly indicated by a sort of genealogical tree herewith shown:

HYPOTHESIS CONCERNING THE DISINTEGRATION OF URANIUM

$$\left.\begin{array}{l}\text{Uranium}\\ \quad\downarrow\ \searrow\ \text{3 Helium}\\ \text{Radium}\\ \quad\downarrow\ \searrow\ \text{1 Helium}\\ \text{Emanation}\\ \quad\downarrow\ \searrow\ \text{4 Helium}\\ \text{Lead (Isotopic)}\end{array}\right\}\ \text{8 Helium}$$

Thus each atom of uranium is supposed to be converted into radium by losing three atoms of helium, and each atom of radium is supposed to be converted into a kind of lead by losing five more, as already stated.

If uranium can thus disintegrate, should we call it an element? and should we call its smallest particles atoms? The answers depend upon our definition of these two words. If the word "element" is supposed to designate a substance incapable of disintegration, apparently it should not be applied to uranium; neither should the word "atom" be applied to the smallest conceivable particles of this substance. But no one would now maintain that any element is really incapable of disintegration. A method of still retaining the terms in this and analogous cases is to define an element as "a substance which has not yet been decomposed artificially," that is to say, by the hand of man—and an atom as "the smallest particle of such a substance, inferred from physicochemical behavior." The atom, then, is not to be considered as wholly indivisible, but only as indivisible (or at least, as not yet divided) by artificial means. For, as in the case of radium, the disintegration of uranium can not be hastened or retarded by any known earthly agency. So long as it stays intact, the atom of uranium behaves quantitatively in the same fashion as any other atom: Dalton's laws of definite and multiple combining proportions apply without exception to its compounds. In this connection one should remember that the atomic theory, as a whole, including Dalton's and Avogadro's generalizations, is not in the least invalidated by the new discoveries of radioactivity. On the contrary, the atomic theory is entrenched to-day more firmly than ever before in its history.

Interesting speculations by Drs. Russell, Fleck, Soddy and Fajans and others have interpreted in extremely ingenious and plausible fashion the several transitory steps of the changes, and indicate the reasons why the end-products of the decomposition both of uranium and thorium should be very similar to lead, if not identical with it. Therefore a careful study of the properties of lead of indubitably radioactive origin became a matter of great interest, as a step toward confirming these speculations, especially in comparison with the properties of ordinary lead. Such investigations should throw light on the nature of radium and uranium and the extraordinary changes which those metals suffer. Moreover, by analogy, the resulting conclusions might be more or less applicable to the relations of other elements to each other; and the comparison of this new kind of lead with ordinary lead might afford important information as to the essential attributes of elementary substances in general, in case any differences between the two kinds should be found.

Before the subject had been taken up at Harvard University, chemists had already recognized the fact that the so-called uranium-lead is indeed qualitatively very like ordinary lead. It yields a black sulphide, a yellow chromate, and a white sulphate, all very sparingly soluble in water, just as ordinary lead does. Continued fractional crystallization or precipitation had been shown by Professor Soddy and others to separate no foreign substance. Hence great similarity was proved; but this does not signify identity. Identity is to be established only by quantitative researches. Plato recognized, long ago, in an often-quoted epigram, that when weights and measures are left out, little remains of any art. Modern science echoes this dictum in its insistence on quantitative data; science becomes more scientific as it becomes more exactly quantitative.

One of the most striking and significant of the quantitative properties of an element is its atomic weight—a number computed from

the proportion by weight in which it combines with some other element, taken as a standard. There is no need, before this distinguished audience, of emphasizing the importance of the familiar table of atomic weights; but a few parenthetical words about their character is perhaps not out of place. As has been more than once said, the atomic weights of the relatively permanent elements, which constitute almost all of the crust of the earth, seem to be concerned with the ultimate nature of things, and must have been fixed at the very beginning of the universe, if indeed the universe ever had any beginning. They are silent, apparently unchanging witnesses of the transition from the imagined chaos of old philosophy to the existing cosmos. The crystal of quartz in a newly hewn piece of granite seems, and probably is, as compact and perfect as it was just after it was formed, eons ago. We can not imagine that any of its properties have essentially changed during its protracted imprisonment; and, so far as we can guess, the silicon and oxygen of which it was made may have existed for previous eons, first as gas, and then as liquid. The relative weights in which these two elements combine must date at least from the inconceivably distant time when the earth "was without form and void."

Although, apparently, these numbers were thus determined at the birth of our universe, they are, philosophically speaking, in a different class from the purely mathematical constants such as the relation of circumference to the diameter of a circle. 3.14159 . . . is a geometrical magnitude entirely independent of any kind of material, and it therefore belongs in the more general class of numbers, together with simple numerical relations, logarithmic and trigonometric quantities, and other mathematical functions. On the other hand, the atomic weights of the primeval elements, although less general than these, are much more general and fundamental than the constants of astronomy, such as the so-called constant of gravity, the length of the day and year, the proper motion of the sun, and all the other incommensurable magnitudes which have been more or less accidentally ordained in the cosmic system. The physicochemical constants, such as the atomic weights, lie in a group between the mathematical constants and the astronomical "constants," and their values have a significance only less important than the former.

In the lead from uranium, we have a comparatively youthful elementary substance, which seems to have been formed since the rocks in which it occurs had crystallized. Is the atomic weight of this youthful lead identical with that of the far more ancient common lead, which seems to be more nearly contemporary as to its origin with the silicon and oxygen of quartz?

The idea that different specimens of a given element might have different atomic weights is by no means new—it far antedates the discovery of radioactivity.

Ever since the discovery of the definite combining proportions of the elements and the ascription of these proportions to the relative weights of the atoms, the complete constancy of the atomic weights has occasionally been questioned. More than once in the past investigators have found apparent differences in the weights of atoms of a single kind, but until very recently all these irregularities have been proved to be due to inaccurate experimentation. Nevertheless, even thirty years ago the question seemed to me not definitively answered, and careful experiments were made with copper, silver and sodium, obtained from widely different sources, in the hope of finding differences in the atomic weights, according to the source of the material. No such differences whatever were found. More recently Professor Baxter, of Harvard, compared the atomic weights of iron and nickel in meteorites (from an unknown, perhaps inconceivably distant source) and the same terrestrial metals. In these cases also the results were negative. Thus copper, silver, sodium, iron and nickel all appeared to be perfectly definite in nature, and their atoms, each after its own kind, all alike.

The general question remained, nevertheless, one of profound interest to the theoretical

chemist, because it involved the very nature of the elements themselves; and in its relation to the possible discovery of a difference between uranium lead and ordinary lead, it became a very crucial question.

Early in 1913, when the hypothesis of radioactive disintegration had assumed definite shape, Dr. Fajans's assistant, Max Lembert, journeyed to Cambridge, bringing a large quantity of lead from Bohemian radioactive sources, in order that its atomic weight might be determined by Harvard methods, with the precision attainable there. The Carnegie Institution of Washington gave generous pecuniary assistance toward providing the necessary apparatus, in this and subsequent investigations.

The most important precautions to be taken in such work are worthy of brief notice, because the value of the results inevitably depends upon them. The operation consists in weighing specimens of a salt of the element in question, and then precipitating one of the constituents in each specimen, determining the weight of the precipitate, and thus the composition of the salt. In the first place, each portion of substance to be weighed must be free from the suspicion of containing unheeded impurities, otherwise its weight will mean little. This is an end not easily attained, for liquids often attack their containing vessels and absorb gases, crystals include and occlude solvents, precipitates carry down polluting impurities, dried substances cling to water, and solids, even at high temperatures, often fail to discharge their imprisoned contaminations. Especial care was taken that each specimen was as pure as it could be made, for impurity in one would vitiate the whole comparison.

In the next place, after an analysis has once begun, every trace of each substance to be weighed must be collected and find its way in due course to the scale pan. The trouble here lies in the difficulty in estimating, or even detecting, minute traces of substances remaining in solution, or minute losses by evaporation at high temperatures.

In brief, "the whole truth and nothing but the truth" is the aim. The chemical side of the question is far more intricate and uncertain than the physical operation of weighing. The real difficulties precede the introduction of the substance into the balance case. Every substance must be assumed to be impure, every reaction must be assumed to be incomplete, every measurement must be assumed to contain error, until proof to the contrary can be obtained. Only by means of the utmost care, applied with ever-watchful judgment, may the unexpected snares which always lurk in complicated processes be detected and rendered powerless for evil.

After all these digressions, made in order that the problems concerned should be clearly recognized, let us turn to the main object of our quest. In the present case, each form of lead was first weighed as pure chloride, and the chlorine in this salt after solution was precipitated as silver chloride, the weight of which was determined. Precautions too numerous to mention were observed. Thus the weight of chlorine in the salt was found, and by difference the weight of the lead. From the ratio of weights, the atomic weight of lead was easily calculated.

The outcome of the first Harvard trials, published in July, 1914, brought convincing evidence that the atomic weight of the specimen of uranium-lead from Bohemia is really less than that of ordinary lead, the value found being 206.6, instead of 207.2—a difference of 0.3 per cent., far beyond the probable error of experiment. Almost simultaneously preliminary figures were made public by Drs. Hönigschmid and St. Horovitz and Maurice Curie, pointing toward the same verdict.

This result, interesting and convincing as it was, was only a beginning. Other experimenters abroad have since confirmed it, especially Professor Hönigschmid, who had studied at Harvard and understood the necessary refinements of analysis; and many new determinations have been made at the Wolcott Gibbs Memorial Laboratory, with the assistance of Dr. Charles Wadsworth, 3d, and Dr. Norris F. Hall, upon various samples of lead

from radioactive sources in widely separated parts of the world. Messrs. E. R. Bubb and S. Radcliff, of the Radium Hill Company, of New South Wales, kindly sent a large quantity of lead from their radium mines, and a particularly valuable specimen prepared from selected crystals of pure mineral was put at our disposal by Professor Gleditsch—not to mention other important contributions from others, including Professor Boltwood and Sir William Ramsay. Each of these samples gave a different atomic weight for the lead obtained from them, and the conclusion was highly probable that they contained varying admixtures of ordinary lead in the uranium-radium-lead. This was verified by the knowledge that in at least some cases the uranium ore actually had been contaminated with lead ore. The purest Norwegian specimen thus acquired especial importance and significance, because it was only very slightly, if at all, vitiated in this way. As a matter of fact, it gave 206.08 for the atomic weight in question—the lowest of all. Here are typical results, showing the outcome; many more of similar tenor were obtained.

ATOMIC WEIGHTS

Common lead	207.20, 207.19	207.19
Australian Radioactive Lead containing probably 25 per cent. ordinary lead	206.32, 206.36, 206.33, 206.36	206.34
Purest Uranic-lead	206.08, 206.09	206.08

Hönigschmid, from similar pure material, had found figures (206.05) agreeing almost exactly with the last value. One can not help believing that this last specimen of lead is a definite substance, probably in a state almost pure, because of the unmixed quality of the carefully selected mineral from which it was obtained.

A further question now arises: is it a *permanent* substance—really an end-product of the disintegration? Soddy's hypothesis assumes that it is. The only important fact militating against this view is the observation that uranium-lead is always radioactive, and hence might be suspected of being unstable. In various impure specimens, however, the radioactivity is not proportional to the change in the atomic weight; hence the radioactivity is probably, at least in part, to be referred not to the lead itself, but rather to contamination with minute, unweighable amounts of intensely radioactive impurities—other more transitory products of disintegration.[2] If weighable, such impurities would almost certainly *increase*, not *diminish*, the atomic weight; hence their presence could not account for the low value.

Let us compare the actual result for the atomic weight of this kind of lead with the theory of Soddy and Fajans. If this theory is sound, the simple subtraction of eight times the atomic weight of helium from that of uranium, or five times the atomic weight of helium from that of radium, should give the atomic weight of the lead resulting from the disintegration, as follows:

HYPOTHETICAL CALCULATION OF ATOMIC WEIGHT OF URANIUM-LEAD

Atomic weight of uranium..	= 238.18		
8 × atomic weight of helium	= 32.00		
Residue (lead?)	206.18	=	206.18
Atomic weight of radium...	= 225.96		
5 × atomic weight of helium	= 20.00		
Residue (lead?)	205.96	=	205.96
Average hypothetical value for lead		=	206.07
Observed value for uranium-lead[3]..		—	206.08
Difference			0.01

The agreement is remarkably good. Each of the individual calculated values shows less than 0.05 per cent. deviation from the average, and the average itself shows essential identity with fact—a striking confirmation of the theory. This is perhaps the most successful

[2] For this reason the term "radio-active lead" although it describes the fact, is perhaps not from a theoretical point of view the best designation of either uranium or thorium lead; but the term is convenient because it distinguishes between these two forms and common lead.

[3] This is the Harvard result. If Hönigschmid's value is given equal weight, the average observed value would be 206.07, exactly identical with the hypothetical value.

attempt on record to compute an atomic weight from hypothetical assumptions. Usually we are wholly at a loss as to the theory underlying the precise relationships, and must determine our values by careful experiment alone.

The value 206.08 for the atomic weight of lead has further support in the fact that it is more nearly half way between thallium, 204, and bismuth, 208, the two neighboring elements in the periodic system, than is the atomic weight 207.2 possessed by ordinary lead.

It appears, then, that 206, the value pertaining to uranium-lead, is a very reasonable value.

But, as has been repeatedly pointed out, ordinary lead, constituting the vast bulk of the lead in the world, has without doubt a much higher atomic weight, 207.2, not to be expected from either of the lines of reasoning just given. In order to test the uniformity of this circumstance, Professor Baxter, of Harvard, with the help of one of his assistants, investigated ordinary lead from non-uraniferous ores from many parts of the world, and discovered that the constancy of its quantitative behavior is as striking as that of copper or silver. His figures agreed very closely, within the limit of error of experimentation, with those obtained as a part of the present comparison of the two kinds of lead, so that there could be no question as to lack of identity of methods or precautions.

Before leaving the subject of the relative atomic weights of these two types of lead, it is not without interest to note the exact absolute weights of the atoms. If, as we have excellent reason for believing on the basis of the brilliant work of Professor R. A. Millikan, a so-called gram-atom (the atomic weight in grams) contains 606.2 sextillion actual atoms, the weights of the atoms of the two kinds of lead must be respectively 342 and 340 septillionth of a gram. Their extreme smallness, as regards bulk, may perhaps best be inferred from the consideration that the smallest object visible as a point in the common microscope has a diameter probably about one thousand times as great as an atom of lead.[4]

Evidently, on the basis of the quantitative results just exhibited, we must admit that there is at least one real difference between radioactive lead and the common metal. Are there other differences?

A question as to the density of each substance, and therefore as to the bulk occupied by the respective atoms, at once arises. Since the atom of uranium-lead weighs less than the other, it must occupy less space, supposing that it has the same density; or else it must have less density, supposing that it should occupy the same space. The identity of the chemical behavior of the two types of lead suggests the probability of the latter alternative, and this was therefore assumed by Soddy; but experimental proof was evidently desirable. Therefore an extended investigation of the density of the various kinds of lead was carried out likewise in the Gibbs Memorial Laboratory. As a matter of fact, the densities of the several specimens were found to be very nearly proportional to their atomic weights; that is to say, the bulk of the atom of radioactive lead is almost exactly the same as the bulk of the atom of ordinary lead, although the weights of these atoms are so markedly different.

DENSITIES AND ATOMIC VOLUMES

	Automatic Weight	Density	Atomic Volume
Pure uranio-lead	206.08	11.273	18.281
Australian mixture	206.34	11.289	18.278
Pure common lead	207.19	11.337	18.277

A distinctive property of elementary substances, which has always been supposed to be concerned more or less definitely with the atomic weight, is the spectrum, depending upon the wave-lengths of light emitted by the vapor. But, surprisingly enough, the spectrum lines produced by these two sorts of lead, when heated to the high temperature of the electric arc, are so precisely alike, both as to

[4] If the smallest object visible in a microscope could be enlarged to the width of this printed page, the atoms in it would appear about the size of the dots on the letters i, or the periods, in the type above.

their wave-lengths and their intensities, that no ordinary spectrum analysis shows any difference whatever. This has been proved by careful experiments at Harvard and elsewhere, and is made obvious by the photographs now thrown on the screen. A and B were from two different specimens of radioactive lead, C from ordinary lead, all very carefully purified. The range covered is about from 3,000 to 2,000 wave-length—far in the ultra-violet. Very recently Professor W. D. Harkins, of Chicago, and two assistants, have detected, with a very extended grating spectrum, an exceedingly minute shift (0.0001 per cent. of the wave length—an amount far too small to be shown by the spectra exhibited) of one of the lines. The wonder is, not that there should be a difference, but rather that they should be so very nearly identical. Evidently the very considerable difference in the atomic weight produces only a barely perceptible effect on the wave-lengths of light emitted by the several isotopic forms of a given element, although a less difference in atomic weight between two different elements (for example, cobalt and nickel) is concomitant with utterly divergent spectra.

Another very interesting question, involving the relations of substance both to light and to weight (or rather density) is its refractive index. All the formulæ relating to molecular refraction involve the *density* of the substance concerned. In the case under consideration, do the differing weights of the atoms, and therefore the differing densities of the same compounds of the two kinds of lead, affect the refractive indices of the salts? It the refractive index of a given salt of radio lead identical with that of the same salt of ordinary lead? Evidence on this point would go far to decide whether density or atomic volume is the more important thing in determining refractive index. A very careful study carried out with the help of Dr. W. C. Schumb at Harvard has within the past few months shown that as a matter of fact the refractive index or ordinary lead nitrate is identical with that of the nitrate of radiolead within one part in nearly twenty thousand, a result which shows that density is a less important factor in deterining refractive index than had been previously assumed.

Both of these conclusions concerning light—that drawn from the spectra and that drawn form the refractive indices—have a yet more far reaching interest, for they give us a further clue as regards the innermost nature of the atom. That part of the atom which determines its weight seems to have, at least in these cases, very little effect on that part of the atom which determines its behavior toward light.

Immediately connected with the question of density of the solid salts is the question as to the densities of their saturated solutions, as well as to the extent of saturation. Fajans and Lembert had recently obtained results probably indicating that the molecular solubility of each kind of lead is the same, and that the densities of the solutions are different, the density of the radiolead solution being less to an extent consistent with its smaller molecular weight. These results, however, left much to be desired in the way of accuracy, and needed verification. Therefore a very careful investigation, begun at Harvard with the assistance of Schumb, before the appearance of Fajan's publication, furnished valuable knowledge on this point.

SOLUBILITY OF TWO KINDS OF LEAD NITRATE*

	Common Lead	Uranium Lead
Per cent. salt in saturated solution (25.00°)	37.342	37.280
Grams lead per 100 grams water	37.28	37.130
Molecular solubility per 1,000 grams water	1.7993	1.7989

Here, again, differences in weight alone are manifest, and these are proportional to the differences in the atomic weights; the molecular behavior is essentially identical in the two sorts.

The identity in solubility might also be inferred from the impossibility of separating the

* The uranium lead used in these determinations was a specimen from Australia having the atomic weight 206.41, not quite like the earlier sample, but not different in important degree.

two kinds of lead from each other by fractional crystallization. This was predicted by Soddy, and tested by him and by others. Various vain attempts have been made to separate the different kinds of lead from one another, but apparently when once they are mixed, no chemical method can separate them, since the properties of the different kinds are so nearly alike. The latest attempt at the Gibbs Memorial Laboratory involved one thousand fractional crystallizations of the Australian lead nitrate, which is believed to contain both ordinary and uranium-radium-lead. The extreme fraction of the crystals (representing the least soluble portion, if any difference in solubility might exist) gave within the limit of error the same atomic weight as the extreme fraction of the mother liquor (representing the most soluble portion), thus confirming the work of others in this direction.

When wires constructed of two different metals are joined, and the junction heated, an electrical potential or electromotive force is produced at the junction. This property seemed, then, to be a highly interesting one to test, in order to find out how great may be the similarity of the two kinds of lead. In fact, wires made of radioactive lead and ordinary lead tested in the Gibbs Laboratory gave no measurable thermoelectric effect, the wires acting as if they were made of the same identical substance, although the atomic weights and densities were different. No other known case of this sort is known, so far as I am aware. The melting points of the two kinds of lead were likewise found, with the assistance of N. F. Hall, to be identified within the probable accuracy of the experiment.

Let us bring all these results together into one table, so that we may better grasp their combined significance.

Summed up in a few words, the situation appears to be this: At least two kinds of lead exist: one, the ordinary metal disseminated throughout the world, in non-uraniferous ores; another, a form of lead apparently produced by the decomposition of uranium, radium being one of the intermediate products. If we leave out of consideration the probably inessential difference in radioactivity, the two kinds are very closely if not exactly alike in every respect, excepting atomic weight, density and immediately related properties involving weight, such as solubility. Thorium lead appears to be a third variety, with similar relations. Shall we call these substances different elements, or the same? The best answer is that proposed by Soddy who invented a new name, and called them "isotopes" of the same element.

COMPARISON OF PROPERTIES OF DIFFERENT KINDS OF LEAD[5]

	Common Lead	Mixture (Australian)	Uranio-Lead	Percentage Difference	
	A	B	C	A–B	A–C
Atomic weight..	207.19	206.34	206.08	0.42	0.54
Density........	11.337	11.289	11.273	0.42	0.56
Atomic volume..	18.277	18.278	18.281	0.01	0.02
Melting point (absolute)....	600.53	600.59	—	0.01	—
Solubility (metal as nitrate)....	37.281	37.130	—	0.41	—
Refractive index of nitrate	1.7815	1.7814	—	0.01	—
Thermoelectric effect........	—	—	—	0.00	—
Spectrum wave length	—	—	—	0.00	0.00

Since every new fact concerning the behavior of the elements gives a new possible means of discovering something about their nature, and since these facts are of especially significant kind, the anomaly is of more than passing interest, and may be said to constitute one of the most interesting and puzzling situations now presented to the chemist who looks for the deeper meanings of things.

Many new queries arise in one's mind from a study of the data. Among them is a question as to the nature of ordinary lead, which possesses a less reasonable atomic weight than the radioactive variety. Why should this state of things exist?

Ordinary lead may be either a pure substance, or else a mixture of uranium-lead with lead of yet higher atomic weight, perhaps 208. The latter substance might be formed, as

[5] For the sake of better comparison, all the results given are those obtained at Harvard. No results of experiments elsewhere are inconsistent with these.

Soddy points out, if thorium (over 232) lost six atoms of helium, and he and Hönigschmid have found quantitative evidence of its existence in thorium minerals.

After reviewing all the data, Professor F. W. Clarke has brought forward an interesting and reasonable hypothesis explaining the difference between the several kinds of lead. He points out that whereas we have every reason to believe that uranium and thorium lead are the results of disintegration of heavier atoms, ordinary lead may be imagined to be the product of a far earlier synthesis or evolution from smaller atoms. The hypothesis might be supported by the analogy of the synthesis and decomposition of organic substances, which by no means always follow similar paths; it seems to be consistent with most, if not all, of the facts now known.

On the other hand, may not the uniformity of ordinary lead and its difference from either of the radioactive leads be almost equally capable of interpretation in quite a different fashion? Whenever, in the inconceivably distant past, the element lead was evolved, it is hardly to be supposed that uranium-lead and thorium-lead could have been entirely absent. The conditions must have been chaotic and favorable to mixture. When the two or more forms were mixed, none of the processes of nature would separate them. Therefore they must appear eons afterwards in an equably mixed state on earth, constituting our ordinary lead. There may have been more than two forms of lead; but two forms, one possessing an atomic weight 206 and the other, an atomic weight over 208, would account for all the facts. The identity in nature of all the common lead on earth might indicate merely that one time all the matter now constituting the earth was liquid or gaseous in violent agitation, so that all the kinds of lead were thoroughly commingled before solidification. This explanation, if it could be confirmed, would furnish important evidence concerning the early history of planets. So far afield may a difference in weight amounting to two units in the twenty-fourth decimal place, between two kinds of atoms so small as to be far beyond the possible range of our most piercing means of actual observation, carry the inquiring investigator!

The true answers to these questions are not to be found by speculation, such as that just detailed, however suggestive such speculation may be. They are to be found by careful observation. For example, the doubt as to the nature of ordinary lead can only be decided by discovering whether or not it may be separated into two constituents. Since weight (or mass) is the quality distinguishing between the several isotopes or kinds of lead, weight (or mass) must be made the basis of separation. Hence the only hope of separating isotopes of lead lies in the method of fractional diffusion, as has been already suggested by many other experimenters on this subject. Promising preliminary experiments preparatory to such an undertaking have already been begun at Harvard, and before long more light may be obtained.

The idea that other elementary substances also may be mixtures of two or more isotopes has been advanced by several chemists. Especially if ordinary lead should really be found to be thus complicated, many, if not all, other elements should be tested in the same way. The outcome, while not in the least affecting our table of atomic weights as far as practical purposes are concerned, might lead to highly interesting theoretical conclusions.

How can such remote scientific knowledge, even if it satisfies our ever-insistent intellectual curiosity, be of any practical use? Who can tell? It must be admitted that the relationship is apparently slight as regards any immediate application, but one can never know how soon any new knowledge concerning the nature of things may bear unexpected fruit. Faraday had no conception of the electric locomotive or the power-plants of Niagara when he performed those crucial experiments with magnets and wires that laid the basis for the dynamo. Nearly fifty years elapsed before his experiments on electric induction in moving wires bore fruit in a practical electric lighting system; and yet more years before the trolley car, depending equally upon the principles discovered by Faraday, became an everyday occurrence. At the time of discovery, even

if the wide bearing and extraordinary usefulness of his experiments could have been foreseen by him, they were certainly hidden from the world at large.

The laws of nature can not be intelligently applied until they are understood, and in order to understand them, many experiments bearing upon the fundamental nature of things must be made, in order that all may be combined in a far-reaching generalization impossible without the detailed knowledge upon which it rests. When mankind discovers the fundamental laws underlying any set of phenomena, these phenomena come in much larger measure than before his control, and are applicable for his service. Until we understand the laws, all depends upon chance. Hence, merely from the practical point of view, concerning the material progress of humanity, the exact understanding of the laws of nature is one of the most important of all the problems presented to man; and the unknown laws underlying the nature of the elements are obviously among the most fundamental of these laws of nature.

Such gain in knowledge brings with it augmented responsibilities. Science gives human beings vastly increased power. This power has immeasurably beneficent possibilities, but it may be used for ill as well as for good. Science has recently been blamed by superficial critics, but she is not at fault if her great potentialities are sometimes perverted to serve malignant ends. Is not such atrocious perversion due rather to the fact that the ethical enlightenment of a part of the human race has not kept pace with the progress of science? May mankind be generous and high-minded enough to use the bountiful resources of nature, not for evil, but for good, in the days to come!

THEODORE W. RICHARDS

HARVARD UNIVERSITY

PROCEEDINGS OF THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE seventy-first meeting of the American Association for the Advancement of Science was held at Baltimore from December 23 to 28, and in view of the unusual conditions it has been a decided success. It will be remembered that the meeting place was changed from Boston to Baltimore, partly because war conditions had brought together at Washington scientific men from all over the country, and it was planned to have a brief compact program devoted to war issues and topics more intimately pertinent to the immediate welfare of the country. While it was not feasible to have the meetings in Washington, it was thought that members in Washington might be able to attend meetings at Baltimore, but a short distance away.

With the sudden termination of hostilities the problems confronting the scientific workers have to a large extent either suddenly changed their nature altogether or have been considerably modified and, although but a short time has intervened since the signing of the armistice, the nature of the contributions and discussions in the various meetings shows a quick recognition and adjustment to these changed conditions.

The rapid release of men by demobilization and the prevalent less congested conditions as to university buildings and hotel accommodations have apparently been partly responsible for the surprisingly large enrollment. The opening meeting at McCoy Hall on the evening of December 26 had an attendance of about four hundred people, and the total registration for the week was seven hundred and twenty-eight, which did not include some of the members of the various affiliated societies. At the opening meeting Dr. Edward L. Nichols announced that the address of the retiring president of the association, Dr. Theodore W. Richards, on "The Problems of Radioactive Lead" would not be given, Dr. Richards being

unable to attend the meeting on account of illness. Dr. Nichols then introduced the president-elect, Dr. John M. Coulter, who in turn presented President Goodnow, of the Johns Hopkins University.

In his address of welcome Dr. Goodnow spoke as follows:

It is my privilege on behalf of the Johns Hopkins University to bid you welcome here to-night. It has been a great pleasure for us to feel that we have been able even in a small way to be of service to you on the occasion of this meeting.

It is always an honor for a university to cooperate with the association. But, at the present time, it is peculiarly gratifying to have the opportunity of testifying to the worth of the work which men of science have been and are now doing.

Science has within the past few years assumed perhaps a greater importance than it has ever before had, or, at any rate, the accomplishments of science have bulked larger in the public eye than heretofore. The struggle which has just closed has probably made greater demands on the scientific man than have ever hitherto been made. Science has, indeed, been forced to become the servant of Mars. The great war has called upon men of science to devise new weapons of both offense and defense. Without their efforts it would have been a very different conflict from what it has been.

The ruthlessness with which our knowledge of scientific law has recently been applied to the destruction of life and property has, I am afraid, however, caused not a few to entertain a certain amount of apprehension as to the effects upon human life of scientific training. If a greater scientific knowledge is to bring with it the will to use that knowledge as it has been used during the past four years, civilization, which has been the product of so many centuries of human endeavor, would seem to have a perilous future.

Such apprehensions are, however, I am sure, quite unfounded. Science, it is true, is in large measure unmoral. It has to do with natural law rather than with human relationships, and it is with human relationships that morality is concerned. Knowledge, of course, is power, and power or might is not necessarily right.

We are told, it is true, that man can not live by bread alone. But that is not to say that he does not live at all by bread. He must have bread and he must have science. We must, so long as we live, attempt to increase our knowledge. We must endeavor through science to acquire power, to conquer Nature, to learn from her how best we may live.

But that endeavor need not prevent us from at the same time striving to live well-ordered lives, to form a social organization in which right relationships shall be established, in which right rather than might shall be controlling. We may at the same time search for truth and labor for the adoption of ethical standards in accordance with which our knowledge of science may be applied.

I have said that in no period in the past has science assumed such importance as in the last four years. I may add that the rôle of science in the immediate future will be of even greater significance. In the period of reconstruction upon which we are now entering, science will be called upon to bind the wounds of a bleeding world sick almost unto death. It must in some way show us how to increase production in order that we may feed the starving, house those without shelter, and clothe the naked. Never before have the demands upon the scientific man been so insistent as they soon will be. And fortunately they will be demands which he can meet without any secret lurking thought that his success will be followed by sorrow and misery. He can rejoice in the belief that his efforts will bring comfort to many whose lot has been hopelessness if not despair.

For this reason I congratulate you men of science upon the opportunity which now presents itself. We are living in a very different world from that which existed only four years ago. Old traditions have been cast aside. New standards are in process of adoption. Great impetus has been given to the belief in the necessity of scientific research.

I wish you all success in this, your first meeting in the new era upon which we are just entering.

In behalf of the Association the response to President Goodnow's welcome was made by Dr. Coulter, as follows:

In behalf of the association, I wish to express our appreciation of the greeting extended by President Goodnow. Johns Hopkins University is a peculiarly fitting place for a meeting of the American Association, for historically it is our first research university, an example and a stimulus to the other universities of the country. Those

of us who are older can recall the distinguished names that brought to Johns Hopkins its prestige in research.

President Goodnow has characterized science as a power let loose for destruction during the late war, a giant that has discovered its strength. Everything depends upon how the power is applied, but I am sure that science prefers to apply its strength in public service rather than in destruction. The great war has been called a war of science, but I trust that this kind of service that science has been called upon to render is but a prelude to a recognition of the fact that the progress of a peaceful civilization is also based upon scientific research.

Speaking for this association, I am sure that we are ready to pledge ourselves to use our science in constructive work, for the advancement of knowledge and for the public welfare.

In accordance with the present constitution, notice was served by Dr. Edward L. Nichols that a revised constitution and by-laws will be presented next year to be voted upon, the principle changes being those of increase in the number of sections and a condensation in form of the present constitution.

Meeting in affiliation with the association were twenty-one other organizations, as follows, many of these affiliated societies having certain sessions in conjunction with corresponding sections of the association:

American Federation of Teachers of the Mathematical and Natural Sciences,
American Physical Society,
Optical Society of America,
Society for Promotion of Engineering Education,
Geological Society of America,
Association of American Geographers,
Paleontological Society of America,
American Society of Naturalists,
American Society of Zoologists,
American Association of Economic Entomologists,
Botanical Society of America,
American Phytopathological Society,
Ecological Society of America,
American Anthropological Association,
American Psychological Association,
American Folk-Lore Society,
American Metric Association,
Society of American Bacteriologists,
American Society for Horticultural Science,
Society of American Foresters,
School Garden Association of America.

Two of the affiliated societies met on Monday and Tuesday in advance of the opening meetings of the association: The School Garden Association of America and the American Phytopathological Society, the sessions of the latter organization continuing till Saturday.

The various meetings were held in Gilman, Hall, the Civil Engineering Building, and the Mechanical and Electrical Engineering Building, at the splendid new site of Johns Hopkins University at Homewood, towards the northern part of Baltimore, and the accommodations for the meetings of the various societies and sections were found to be convenient and amply sufficient. Inexpensive and ample lunches were provided in the Mechanical and Electrical Engineering Building.

There were held perhaps the usual numbers of dinners and smokers, at which addresses of retiring presidents, invitation papers, or other interesting features were presented. The Phytopathological Society had a dinner on Wednesday evening and the Ecologists an informal dinner on Thursday evening, while after the opening session of the association, the biologists gathered for an informal smoker. On Friday evening, dinners were held by the botanists, the American Metric Association, the American Society for Horticultural Science, while the Society of American Foresters had a smoker and "Round Table Talks." On Saturday night the American Society of Naturalists held a dinner, at the close of which Vernon L. Kellogg was to have spoken on "The German Philosophy of the War" but was detained in France. The annual dinner of

the Geological Society was held at the same time elsewhere. The Association of University Professors met on Saturday at the Hopkins Club.

In the Botanical Laboratories in Gilman Hall there was displayed an exhibit showing the use of sphagnum moss in the preparation of surgical dressings, as prepared by Dr. Geo. E. Nichols, Botanical Adviser on Sphagnum for the American Red Cross.

Some of the most noticeable features of the Baltimore meeting were the tendency towards cooperation and team-work among investigators, attacking problems jointly under well-developed plans, and the considerable number of notable addresses, often given by men of large responsibilities in governmental or war work and relating the problems of reconstruction. The experiences of the past two years have had an important bearing on methods of research and an important address was that given by Dr. George E. Hale, entitled "The National Research Council," in which the future organization and functioning of that institution were discussed. Altogether it is probably safe to state that about four hundred addresses and shorter papers were presented at the various meetings.

The addresses of the retiring vice-presidents were as follows:

Section A.—Henry Norris Russell, on "Some problems of sidereal astronomy."

Section B.—W. J. Humphreys, on "Some recent contributions to the physics of the air."

Section C.—William A. Noyes, on "Valence."

Section D.—Henry Sturgis Drinker, on "The need of conservation of our vital and natural resources as emphasized by the lessons of the war."

Section E.—George Henry Perkins, on "Vermont physiography."

Section F.—Herbert Osborn, on "Zoological aims and values."

Section G.—Burton E. Livingston, on "Some responsibilities of botanical science."

Section H.—E. L. Thorndike, on "Scientific personnel work in the army."

Section L.—Edward F. Buchner, on "Scientific contributions of the educational survey."

Section M.—Henry J. Waters, on "The farmer's gain from the war."

As honorary associates of the Baltimore meeting the council elected Dr. Professor Fabio Frassetto, of the University of Bologna and now of the Royal Italian Embassy at Washington, and Dr. Georgio Abetti, vice-secretary of the Italian Society for the Advancement of Science, both of these men being in attendance at the meetings.

The next meeting of the association will be held in St. Louis, beginning the first Monday after Christmas, 1919. The results of elections of officers for the ensuing year were as follows:

President: Simon Flexner, director of the Rockefeller Institute for Medical Research, New York City.

Vice-Presidents:

Section B.—Theodore Lyman, Harvard University, Cambridge, Mass.

Section C.—B. F. Lovelace, The Johns Hopkins University, Baltimore, Md.

Section E.—C. K. Leith, University of Wisconsin, Madison, Wis.

Section F.—Wm. M. Wheeler, Bussey Institution, Boston, Mass.

Section G.—L. H. Pammel, Iowa State College, Ames, Iowa.

Section H.—R. M. Yerkes, University of Minnesota, Minneapolis, Minn.

Section L.—V. A. C. Henmon, University of Wisconsin, Madison, Wis.

Section M.—A. F. Woods, Maryland Agricultural College, College Park, Md.

Secretary of the Council: J. F. Abbott, Washington University, St. Louis, Mo.

General Secretary: Geo. T. Moore, Missouri Botanic Garden, St. Louis, Mo.

Nine men were elected members of the committee on grants, as follows: N. L. Britton, Louis I. Dublin and J. McK. Cattell for one year; G. N. Lewis, W. B. Cannon, and R. T. Chamberlin for two years; and Henry Crew, Joel Stebbins, and G. H. Parker for three years.

To fill vacancies in the council of the association Drs. N. L. Britton and J. McK. Cattell were reelected and Dr. J. C. Merriam was elected as a new member. Dr. E. F. Buchner was appointed to represent the association in the American Council of Education, and J. C. Merriam, H. B. Ward, and Stewart Paton were elected to serve for three years on the Committee on Policy.

The report for 1918 of the treasurer of the association, Dr. Robert S. Woodward, showed total cash receipts of $7,747.27 and disbursements $7,786.00, including the purchase of $4,000 Liberty Bonds. The total funds of the association are now $116,605.45.

The financial report of the permanent secretary, L. O. Howard, for the period November 1, 1917, to October 30, 1918, showed receipts $43,784.49 and expenditures of $36,209.04, leaving a balance of $7,575.45.

The two financial reports will be printed in full in a later issue of SCIENCE.

O. E. JENNINGS,
General Secretary.

SCIENTIFIC EVENTS

THE KATMAI NATIONAL MONUMENT

PRESIDENT WILSON has created by proclamation the Katmai National Monument. This reservation incloses what the explosive eruption of June, 1912, left of Mount Katmai, on the southern shore of Alaska, together with several neighboring valleys of steaming vents, the largest of which the National Geographic Society, which explored it in June, 1917, named the "Valley of Ten Thousand Smokes."

The two features are intimately related. Rock strata superheated since the great eruption underlie Katmai near enough to the surface to turn to instant steam the spring and drainage waters of many a surrounding mile of foothills. Thus originates the steam which bursts from the myriad valley vents. The phenomenon is familiar in the neighborhood of most volcanoes which still are classed as active. Steaming springs, a later stage of the vents in this valley, are found upon the flanks of several of the most prominent of our Cascade volcanoes, and are numerous around the base of Lassen Peak.

The comparison, however, between Katmai's steaming valleys and the geyser basins of Yellowstone is especially instructive because Yellowstone's basins once were what Katmai's steaming valleys are now. The "Valley of Ten Thousand Smokes" is probably a coming geyser field of enormous size. The explanation is simple. Bunsen's geyser theory, now generally accepted, presupposes a column of water filling the geyser vent above a deep rocky superheated chamber in which trickling spring water is being rapidly turned into steam. When this steam becomes plentiful enough and sufficiently compressed to overcome the weight of the water in the vent, it suddenly expands and hurls the water out. That is what makes the geyser play.

Now, the difference between the Yellowstone geyser fields and Katmai's steaming valleys is just a difference in temperature. The entire depth of earth under these valleys is heated far above boiling point, so that it is not possible for water to remain in the vents; it turns to steam as fast as it collects and rushes out at the top in continuous flow. But when centuries or hundreds of centuries enough elapse for the rocks between the surface and the deep internal pockets to cool, the water will remain in many vents as water until, at regular intervals, enough steam gathers below to hurl it out. Then these valleys will become

basins of geysers and hot springs like Yellowstone's.

The crater of Katmai is very large. Its circumference, says Robert F. Griggs, who headed the expeditions which explored the entire area, is 8.4 miles, measured along the highest point of the rim.

The area is 4.6 miles. The precipitous abyss, which does not extend to the rim of the southwest side, is somewhat shorter, measuring 2.6 miles in length, 7.6 miles in circumference, and 4.2 square miles in area. The milky blue lake at the bottom is 1.4 miles long and nine tenths of a mile wide, with an area of 1.1 square miles. The little cresent-shaped island in the lake measures 400 feet from point to point. The precipice from the lake to the highest point of the rim is 3,700 feet.

Mr. Griggs estimates the capacity of the hole at 4,500,000,000 cubic yards. If this hole were filled with water, there would be enough to supply New York City for 1,635 days. The great eruption blew out 11,000,000,000 cubic yards of material, more than forty times the amount removed in the construction of the Panama Canal.

AGRICULTURAL PRODUCTION IN THE UNITED STATES

How American farmers responded to the food needs of the United States and the countries with which it was associated in the war is described in detail in the annual report of the Secretary of Agriculture, David F. Houston, just made public.

For wheat and other leading cereals and for potatoes, tobacco and cotton, farmers in 1918 planted 289,000,000 acres, an increase over the preceding record year of 5,600,000. It is especially noteworthy, the secretary points out that, while the acreage planted in wheat in 1917 was slightly less than for the record year of 1915, it exceeded the five-year average (1910–14) by 7,000,000; that the acreage planted in 1918 exceeded the previous record by 3,500,000; and that the indications are that the acreage planted during the current fall season will considerably exceed that of any preceding fall planting.

Notwithstanding adverse climatic conditions in 1917, especially for wheat, and in 1918 especially for corn, the secretary reports that only 1915 has exceeded either 1917 or 1918 in the aggregate yield of wheat and other leading cereals.

"The estimated total for 1917," he explains, "was 5,796,000,000 bushels and for 1918, 5,638,000,000 bushels, a decrease of approximately 160,000,000 bushels. But the conclusion would be unwarranted that the available supplies for human food or the aggregate nutritive value will be less in 1918 than in 1917. Fortunately, the wheat production for the current year—918,920,000 bushels—is greatly in excess of that for each of the preceding two years, 650,828,000 in 1917, and 636,318,000 in 1916, and is next to the record wheat crop of the nation. The estimated corn crop, 2,749,000,000 bushels, exceeds the five-year pre-war average by 17,000,000 bushels, is 3.4 per cent. above the average in quality and greatly superior to that of 1917."

Turning to live stock, the secretary notes that the number of pounds of beef for 1918 is given at 8,500,000,000 pounds, as against 6,079,000,000 for 1914, the year preceding the European war; and that the total for 1918 of beef pork and mutton is given at 19,495,000,000 pounds, as against 15,587,000,000 pounds for 1914.

On the basis of prices that have recently prevailed, the secretary says, the value of all crops produced in 1918 and of live stock on farms on January 1, including horses, mules, cattle, sheep, swine and poultry, is estimated to be $24,700,000,000, compared with $21,325,000,000 for 1917 and $11,700,000,000, the annual average in the five-year period 1910 to 1914. This greatly increased financial showing, the secretary explains, does not mean that the nation is better off to that extent, or that its real wealth has advanced in that proportion. Considering merely the domestic relations, the true state is indicated rather in terms of real commodities. The increased values, however, do reveal that monetary returns to the farmers have increased proportionately with those of other groups of producers in the nation and that their purchasing power has kept pace in the rising scale of prices.

Yields in 1918 of the major food crops were as follows, according to unrevised estimates: 2,749,198,000 bushels of corn; 918,920,000 bushels of wheat; 1,535,297,000 bushels of oats; 236,505,000 bushels of barley; 76,687,000 bushels of rye; 18,370,000 bushels of buckwheat; 41,918,000 bushels of rice; 61,182,000 bushels of kafirs; 390,101,000 bushels of Irish potatoes; 88,114,000 bushels of sweet potatoes; 17,802,000 bushels of commercial beans; 40,185,000 bushels of peaches; 10,342,000 bushels of pears; 197,360,000 bushels of apples; 6,549,000 tons of sugar beets; 29,757,000 gallons of sorghum sirup; 52,617,000 bushels of peanuts.

The estimated 1918 production of all the cereals, 5,638,077,000 bushels, compares with 5,796,332,000 bushels in 1917, and 4,883,819,000 bushels, the annual average in the five-year period 1910–14. On January 1, 1918, it is estimated there were on American farms 21,563,000 horses, compared with an average of 20,430,000 in the five years 1910–14; 4,824,000 mules, compared with 4,346,000; 23,284,000 milch cows, compared with 20,676,000; 43,546,000 other cattle, compared with 38,000,000; 48,900,000 sheep (an increase, for the first time in many years, over the preceding year), compared with 51,929,000; 71,374,000 swine, compared with 61,865,000.

The estimated 1918 production of beef, 8,500,000,000 pounds, compares with 7,384,007,000 pounds in 1917; 10,500,000,000 pounds of pork compared with 8,450,148,000; 495,000,000 pounds of mutton and goat meat compared with 491,205,000; 8,429,000,000 gallons of milk produced in 1918 was 141,000,000 pounds more than the 1917 production; 299,921,000 pounds of wool, 18,029,000 pounds more than 1917; 1,921,000,000 dozens of eggs, 37,000,000 dozens more; 589,000,000 head of poultry, 11,000,000 more.

THE EDWARD K. WARREN FOUNDATION AND TWO WILD LIFE RESERVATIONS IN MICHIGAN

It will be of interest to zoologists and botanists, particularly ecologists and those interested in the fauna and flora of the Middle West, to learn what two areas in southwestern Michigan have been set aside as wild life preserves. The tracts comprise 300 acres (150 or more of the original forest) situated two and a half miles north of Three Oaks, in Chickaming Township, Berrien County, and over 250 acres in the sand dune region on the shore of Lake Michigan, in Lake Township, two miles north of Sawyer, in Berrien County.

The forest is a remnant of the original beech-maple forest of southern Michigan. It has never been cut or burned over and many of the trees are splendid specimens, fifty to seventy feet in height to the first limb, and from two to four feet in circumference. The Galien River flows through the forest for about one and one half miles and there are numerous springs.

The sand dune tract has a frontage on Lake Michigan of about 3,000 feet. It includes probably the highest dunes in the State of Michigan, the largest of which are from two hundred to three hundred feet in height. Much of the tract is wild and with little doubt the original vegetation prevails in most places.

The preserves have been established by Mr. and Mrs. Edward K. Warren, of Three Oaks, Michigan, and are incorporated in the "Edward K. Warren Foundation," which also includes the Chamberlain Memorial Museum at Three Oaks, founded in 1915 and opened to the public in 1916.

The forest has been in Mr. Warren's possession for forty years, and has been preserved by him for its great natural beauty, and both tracts have been set aside that future generations may have an example of the primitive floral and fauna conditions in southern Michigan, that nature lovers may find here many of the animals and plants which are being exterminated elsewhere, and that students of biology may have available a place where they can study native animals and plants in their natural habitats. Some of the sand dune area has been more recently acquired, and it is typical of the good judgment and foresight of Mr. Warren that this area includes the best developed dunes and is the least disturbed tract in the sand dune region.

The Museum of Zoology of the University of

Michigan has been asked to make a detailed survey of the reservations, and it is planned to extend this survey over an indefinite number of years. Field laboratories will be provided by the foundation, and the museum will send specialists on the groups represented in the preserves to these laboratories at different times. The object of the field work will be to obtain a complete inventory of the plants and animals and to secure data upon the causes of fluctuations in numbers of individuals, that the fauna and flora may be maintained as nearly as possible in the primitive condition. At the same time it is expected that ecological data and information on the original biota will be obtained which will be of scientific interest. The specimens will be deposited in the Museum of Zoology and the Chamberlain Memorial Museum, and the published results of the work will appear from the Museum of Zoology under a common title.

Future generations will not fail to appreciate the good judgment and public spirit which have led to the recognition of the desirability of insuring the perpetuity of the wild life of these areas and the establishment of the preserves.

Alexander G. Ruthven
Museum of Zoology,
University of Michigan

THE ORGANIZATION OF YALE UNIVERSITY AND THE SHEFFIELD SCIENTIFIC SCHOOL

Meeting in extraordinary session on December 16, with but one member absent, the Yale Corporation reviewed the whole subject of university reconstruction, and voted fundamental changes which, when carried through, will radically alter the university organization. The important votes are as follows:

1. Voted, That the recommendation of the governing board of the Sheffield Scientific School that the undergraduate course "be lengthened from three to four years" be approved.

2. That in the opinion of the corporation the reasons which led to the establishment and maintenance of a course of "Selected studies in language, literature, history and the natural and social sciences" under the administration of the faculty of the Sheffield Scientific School are no longer valid.

3. That the governing board of the Sheffield Scientific School be requested to appoint a committee, of which the director shall be chairman, to prepare plans for the immediate establishment of a four-year undergraduate course and the discontinuance of the "select" course; reporting at the same time to the corporation whether, in the opinion of this committee, it is desirable to establish a scientific course in preparation for business.

4. That this committee be directed to confer with a similar committee to be appointed by the permanent officers of Yale College regarding the inter-departmental problems created by the proposed changes, in order that properly qualified students in either school may be given access to the courses of instruction offered by the other.

5. That the president be directed to call meetings of the two committees thus created, together with the chairman of the entrance examination committee, to devise means for carrying more fully into effect the policy of joint administration of entrance requirements for the two schools; with authority to recommend, for the consideration of the respective governing boards and the approval of the corporation, such changes as shall appear to them desirable in the scope of the entrance requirements themselves, and in the organization of the freshman year.

6. That in the opinion of the corporation it is practicable, as recommended by the executive board of the graduate school, to place the administration of all advanced degrees and certificates in science, comprising at present the degree of master of science, the certificate in public health, and the higher engineering degrees, under the jurisdiction of the graduate school, without interfering with the development of the departments of study concerned or their proper articulation with the undergraduate courses which lead up to them; and that under these circumstances the administration of the courses leading to these degrees should be transferred to the graduate school at the close of the present academic year.

7. That the executive board of the graduate school be requested to prepare for the consideration of the faculty and the approval of the corporation plans by which provision can be made for the necessary independence and the proper coordination of graduate and undergraduate work in other departments of study as well as in those immediately affected by this change; and to submit such plans to the governing boards of the two undergraduate schools for their information and for any suggestions which they may choose to make in connection therewith.

8. That in adopting the above resolutions the corporation does not thereby commit itself to maintaining as a permanent policy the present division between the college and the Sheffield Scientific School in freshman year.

SCIENTIFIC NOTES AND NEWS

DR. SIMON FLEXNER, director of the laboratories of the Rockefeller Institute for Medical Research, was elected president of the American Association for the Advancement of Science at the meeting held last week in Baltimore. Chairmen of the sections elected are given in the report of the general secretary, published elsewhere in the present issue of SCIENCE.

COLONEL E. D. SCOTT was elected president of the American Psychological Association at the meeting held last week in Baltimore.

AT the meeting of the American Association of University Professors, held in Baltimore during convocation week, Dr. Arthur O. Lovejoy, professor of philosophy in the Johns Hopkins University, was elected president.

DR. GEORGE L. STREETER has been appointed director of the department of embryology of the Carnegie Institution of Washington.

PROFESSOR A. E. KENNELLY, of Harvard University and the Massachusetts Institute of Technology, was elected an honorary member of the Institute of Electrical Engineers, London, November 22, 1918.

LIEUTENANT COLONEL HARVEY CUSHING, professor of surgery at Harvard University, was made last June neurological consultant to the American Expeditionary Forces, with headquarters at Neufchâteau.

DR. WILLIAM T. SHOEMAKER, of Philadelphia, in recognition of his services as ophthalmologist of Base Hospital Unit No. 10, from the Pennsylvania Hospital, which he accompanied to France in May, 1917, has been appointed ophthalmologist to all American hospitals in England, and recently left France to enter upon his new duties. The new appointment carries with it the rank of lieutenant colonel, and he has been recommended for the promotion.

DR. A. D. HIRSCHFELDER, of the University of Minnesota, is now with the research division of the Chemical Warfare Section and has been stationed in Baltimore.

DR. RAYMOND PEARL, chief of the statistical division of the United States Food Administration, has returned to this country from a two months trip in Europe on Food Administration business.

DR. A. G. ELLIS, associate professor of pathology at Jefferson Medical College, will proceed to Siam to organize the department of pathology in the Royal Medical College at Bangkok. The exact date of his departure has not been determined, and is contingent upon the return of Dr. W. M. L. Coplin, professor of pathology, who is with the American Expeditionary Forces in France, having charge of the organization of the hospital laboratories.

THE faculty of the medical school of Northwestern University, Evanston, Illinois, gave a dinner at the Hotel La Salle, Chicago, on December 12, in honor of Professor Emilius C. Dudley, who is retiring from the chair of gynecology after thirty-seven years of work. Many colleagues and friends of Dr. Dudley were there and several speakers both from the faculty and trustees bore witness to his great contribution to the development of modern medicine and the affectionate regard in which he was held.

At a meeting of the fellows of the Royal Society of Medicine, held on November 13, the diploma of honorary fellowship of the society was presented to Sir Alfred Keogh, G.C.B., late director-general of the British Army Medical Services.

Lieutenant Colonel Richard H. Harte, head of Base Hospital Unit No. 10, one of the first American Hospital units to arrive in France, is in the Pennsylvania Hospital recovering from a serious operation.

Mr. Charles D. Test, formerly chemist for the Western Potash Works of Antioch, Nebraska, has accepted a position on the staff of the United States Tariff Commission.

Due to the retirement of Mr. Wallace G. Levison, Edgar T. Wherry, of the Bureau of Chemistry at Washington, has been appointed editor-in-chief of *The American Mineralogist*, with the following associate editors: George F. Kunz, president, New York Mineralogical Club; Herbert P. Whitlock, American Museum of Natural History; Alexander H. Phillips, Princeton University; Waldemar T. Schaller, U. S. Geological Survey; Edward H. Kraus, University of Michigan; Austin F. Rogers, Leland Stanford Junior University; Thomas L. Walker, University of Toronto, Canada; and Samuel G. Gordon, Academy of Natural Sciences, Philadelphia.

At a joint meeting of the Franklin Institute and the Philadelphia Section of the American Chemical Society on December 5, Provost Smith delivered a lecture on "Chemistry in Old Philadelphia." In this lecture the work of twelve pioneers in chemistry was considered.

Professor Maurice A. Bigelow, director of the school of practical arts of Columbia University, recently delivered an address at the Brooklyn Botanic Garden on "Childrens' gardens in the coming reconstruction period."

The second lecture of the series of the Harvey Society will be by Colonel Eugene R. Whitemore on "Infectious diseases in the army." The lecture will be given at the New York Academy of Medicine on Saturday evening, January 11, at 8:30.

The Lady Priestley Memorial Lecture of the National Health Society at the Imperial College of Science and Technology, South Kensington, was given by Professor Bone, F.R.S., who took as his subject "Coal and health."

It is the desire of the American Committee of the Ramsay Memorial Fund to make the fund an expression of the esteem for Sir William Ramsay in this country. Many have expressed a wish to contribute, but have held back on account of their inability to send in a sum commensurate with their esteem. This has been due to the numerous calls made upon all for the past two years. Small sums, from one to five dollars, will be welcomed by the committee, which is anxious to make the expression of appreciation as widespread as possible. Contributions may be sent to Professor Charles Baskerville, chairman, College of the City of New York, or Mr. W. J. Matheson, treasurer, 21 Burling Slip, New York City.

According to a news despatch from France, the names of Lafayette and Wilbur Wright were joined, on December 22, by former Premier Painlevé, who spoke at the ceremonies incident to the laying of the foundation stone of the Wilbur Wright monument at Lemans, France. This was because Lafayette was a deputy of the Department of Sarthe, of which Lemans is the chief town, from 1812 to 1822, and three eminent French aviators, Fonck, Hurteau and Nungesser, were natives of this department. After sketching the lives of the Wright brothers, M. Painlevé said: "Let us honor Wilbur Wright's memory, first, as a good worker for human progress; second, because he brought to France the aid of his genius. Let his memory be joined with those of his young fellow citizens, who spontaneously brought their heroism to our aviation service."

Charles E. Phelps, engineer of the Maryland State Board of Health, formerly chief engineer of the Maryland Public Service Commision, died of pneumonia on December 22, aged forty-seven years.

JOHN P. CAMPBELL, for thirty years professor of biology in the University of Georgia, died on December 3. A correspondent writes that he was eminently a successful teacher and will be remembered by a large number of students whom he inspired. Le Conte Hall, erected in 1906 on the University of Georgia campus, is said to have been the first building in the south dedicated from the start to biological work.

WE learn from the *Journal* of the American Medical Association that the July-August number of the handsome journal issued by the national public health authorities of Cuba is entitled "Numero extraordinario en homenaje a la memorial de Dr. Carlos J. Finlay," on the anniversary of his death. It contains 197 pages with a photograph of Dr. Finlay and of the monument with his portrait bust which has been installed in the court of the headquarters of the public health department, the *Secretaria de Sanidad y Beneficencia*. All Finlay's scientific works are reproduced or summarized, from 1865 to 1912. His communication on the transmission of yellow fever through an intermediary agent was presented to the International Sanitary Conference at Washington, D. C., in 1881. He did not specify the mosquito in that communication, but did this in his address before the Academia de Ciencias Medicas, Fisicas y Naturales, at Havana, August 14, 1881. His address was republished in English and Spanish with the title "The mosquito hypothetically considered as an agent of transmission of yellow fever."

THE annual general meeting of the American Philosophical Society will be held from April 24 to 26, beginning at 2 P.M. on Thursday, April 24.

JOHN A. ROEBLING, of Bernardsville, New Jersey, has offered the British Museum a gift of five $1,000 bonds of the United States Liberty Loan, which is unaccompanied by conditions of any kind and is intended as a mark of community of sympathy which unites England and America. The trustees have accepted the gift and will consider to what purpose it may be most appropriately applied.

THE trustees of the British Museum are considering the question of reopening those parts of the museum which have been closed during the war, and of bringing out the treasures which have been stored in the basement. This may take some time, however, as one wing of the building is being used as the offices of a government department, and many of the exhibits are heavily sandbagged, and labor for uncovering them is not yet available.

WE learn from *Nature* that the British Scientific Instrument Research Association, one of the earliest associations formed under the scheme of the Department of Scientific and Industrial Research, has secured premises at 26 Russell Square, W.C., 1, where offices and research laboratories will be equipped. The first chairman of the association was Mr. A. S. Esslemont, whose recent lamented death has been a severe loss to the association. The council has elected Mr. H. A. Colefax, K.C., as chairman to fill the vacancy. The vice-chairman is Mr. Conrad Beck, to whose energy and personal influence is largely due the successful formation of the association. Almost all the leading optical and scientific instrument manufacturers are members. The department of scientific and industrial research is represented by Major C. J. Stewart, Captain F. O. Creagh-Osborne, R. N., Mr. S. W. Morrison, Colonel R. E. Home, R. A., and Mr. Percy Ashley. The council has recently co-opted as members of its body the Hon. Sir Charles A. Parsons, F.R.S., and Professor J. W. Nicholson, F.R.S. Sir Herbert Jackson, K. B. E., F.R.S., has been appointed director of research and Mr. J. W. Williamson secretary of the association.

WE learn from the London *Times* that the Salters' Company have issued a circular giving the outline of the Salters' Institute, now being founded to promote research in industrial chemistry, and to train students. An important part of the scheme is the foundation of Post-Graduate Fellowships. The new organization will be called "The Salters Institute of Industrial Chemistry," and for the

present will be located at the Salters' Hall, St. Swithin's-lane, E.C. This first business will be the appointment of a director, who must possess an exceptional knowledge of scientific and industrial chemistry. Among other things, the director will make arrangements between manufacturers and students and universities for the investigation of any particular problems requiring research, and give practical advice and information to those who are, or intend to become, industrial chemists, and especially to men whose careers have been interrupted or affected by naval, military, or national service. The Salters' Company will establish two types of fellowships for which post-graduate students of any recognized university will be eligible. The two classes are (*a*) fellowships to enable post-graduate students to continue their studies at an approved university or other institution under the general supervision of the director, (*b*) industrial fellowships to enable suitably equipped chemists to carry on research for any particular manufacturer, under an agreement which will be entered into between the institute, the manufacturer, and the fellow. Grants in aid may also be made to a certain number of persons who desire to improve themselves in the knowledge of their particular work by attending technical establishments or evening classes, at which they can obtain a better grasp of their subject.

At the session of the American Medical Association last June, a petition signed by a large number of the leading neurologists and psychiatrists of the United States and Canada was presented to the board of trustees, asking that the association publish a journal to be devoted to nervous and mental diseases, on a plan similar to that on which the *Archives of Internal Medicine* and the *American Journal of Diseases of Children* are published. The board held the matter under advisement until its October meeting, at which time it acted favorably on the petition, and authorized the publication of such a journal. The journal will be known as the *Archives of Neurology and Psychiatry*. The following were appointed as the editorial board: Dr. Pearce Bailey, New York, adjunct professor and assistant professor of neurology at Columbia University College of Physicians and Surgeons, New York Dr. Augustus Hoch, now of Montecito, Calif., formerly professor of clinical medicine, department of psycho-pathology at Cornell University Medical College; Dr. Hugh T. Patrick, Chicago, clinical professor of nervous and mental diseases, Northwestern University Medical School; Dr. E. E. Southard, Boston, professor of neurology, Medical School of Harvard University; Dr. Frederick Tilney, professor of neurology, Columbia University College of Physicians and Surgeons, New York Dr. T. H. Weisenburg, Philadelphia, professor of neuro-pathology and clinical neurology, University of Pennsylvania School of Medicine.

UNIVERSITY AND EDUCATIONAL NEWS

A gift of $100,000 to the University of Chicago for the erection of a building, preferably an administration building, was announced at the One Hundred and Ninth Convocation, the donor being Andrew MacLeish, vice-president of the university board of trustees. This is but one of a long list of benefactions for which the university is indebted to Mr. MacLeish.

Since building restrictions have been removed by the government, the erection of a number of new buildings, long in contemplation for the University of Tennessee, probably will be begun shortly.

One of the engineering buildings at the Pennsylvania State College was recently destroyed by fire, affecting the departments of industrial and mechanical engineering. A new building was just being completed and a second one has been begun. Temporary provision has been made for a forge shop and the steam engineering laboratory. Plans for other permanent buildings are being considered.

An International Committee for the Restoration of the University of Louvain has

been formed. National committees are being formed in the twenty-four nations which have adhered to the plan.

DR. EDWARD MARTIN, major in the Medical Reserve Corps and stationed at a camp in Georgia, has been elected emeritus professor of surgical physiology at the University of Pennsylvania.

DISCUSSION AND CORRESPONDENCE

LANTERN SLIDES OF NORTHERN FRANCE

IN response to a request from the National War Work Council, Y. M. C. A., for a set of lantern slides to illustrate their cantonment lectures on northern France, I began last June to search for photographs in various official and commercial collections by which the French views in the Gardner photograph collection of Harvard University might be supplemented. The search soon proving unsuccessful, a list of desired views was sent to Professor Lucien Gallois of the University of Paris, in the hope that he might be able to supply them: but he was just then called out with others to aid refugees who had been driven from their homes by the German advance to Château-Thierry on the Marne; and not until October was a shipment of 69 negatives received from him, representing the best selection that he could make under conditions as then limited. Since then a further delay in announcing the series has been occasioned by waiting for some admirable photographs taken during his service in France and lately brought home by Major Douglas W. Johnson.

The series of slides thus formed contains views of unequal value, some being reproduced from half-tone prints; but it represents the best collection I have been able to bring together. The happy coming of the armistice and the resulting dismemberment of the S. A. T. C.'s make the present announcement of the series rather out of season; but as the geography of northern France is likely to be a subject of general collegiate interest for some time to come the slides may be taken as "better late than never." The negatives have been placed in the hands of Mr. B. S. Turpin, 491 Boylston St., Boston, Mass., from whom a list of the slides with statement of cost may be obtained. All correspondence should be addressed to Mr. Turpin.

Good photographs of the following districts are much desired for the improvement of the series: General view of uplands adjoining the valley of the Somme, east of Amiens; uplands near Paris; general view of Laon, showing city on hill surmounting plain; general view of Rheims; escarpment of the first upland belt, southwest of Rheims; valley of the Meuse at Verdun; general view of Nancy; valley of the Orne in west slope of the fifth upland belt; escarpment at the notch of Saverne, looking north; general views in Lorraine east of Metz and of Nancy; view of the Vosges, looking west from the plain of Alsace; view of the plain of Alsace, from the foothills of the Vosges.

W. M. DAVIS

CAMBRIDGE, MASS.

BIOLOGICAL LITERATURE IN ENGLISH

THE German people have seen to it that the scientific literature of the world has been printed in German, that their people may have access to it. Other peoples have not done this, and the result is that the scientific world has been forced to know German. It has become the habit of most of our English and American scientists, as well as those in other countries, to publish their discoveries first in German and then (if they get to it) to publish in their own language.

A few years ago, when desiring an English translation of Fruwirth's "Die Büchtung der landwirtschaftlichen Kulturpflanzen," a four-volume work on the breeding of field crops, the present writer located translators, took up the matter with the publisher, Paul Parey of Berlin, and looked for an English publisher. The American publishing houses agreed that the data should be in English, but considered that they would not sell enough copies to pay for the undertaking.

Is it not about time that the English-speaking people see to it that the scientific literature

be published in English? Germany has furnished public funds when the publisher of technical data was not able to sell enough copies to make a profit. Can't the English people do as well?

The population of Germany was less than 67,000,000 before the war, and suppose that we consider the German-speaking people to be 100,000,000, we find that the United States of America alone has over 100,000,000 people. If we add to this the British Empire with about 438,000,000 we find it likely that about five times as many people speak English as speak German. There is more reason to have the world's scientific literature in English than to have it in German.

We, as biologists, do not realize how completely Germany had our scientific confidence until we pick up a work like the "International Catalogue of Scientific Literature," published in London. Turning to section L of this index, which is general biology, we find that of the 286 journals being quoted from before the war, 169 were German, 49 English, 25 Russian, 14 French, 10 Dutch, 8 Danish, 6 Hungarian, 3 Polish and 2 Swedish. In the German list have been placed the 20 Austrian journals, which are essentially German, 5 printed in Switzerland and 2 in Poland. Of the 49 English journals, 36 are printed in the United States. The French journals are scattered. Three are printed in Switzerland, two in Russia and one in Poland.

Frank A. Spragg

East Lansing, Mich.

A FLOWING ARTESIAN WELL AT WINSLOW, MAINE

Winslow, Maine, is situated on the east bank of the Kennebec River about 83 miles north of Portland. It is directly opposite the city of Waterville, and the buildings of Colby College look across the river upon the artesian area to be described.

The Hollingsworth & Whitney Company, on whose property the flowing well is, has drilled seventeen wells in the last nineteen years. The first series was drilled in 1899 and is described in Water Supply Paper 223.[1] At this time there were seven wells from 110 to 125 feet deep.[2] These are said to have gradually filled with sand, until in 1906 they were about 90 feet deep. At this time they were abandoned because of insufficient supply for the purpose desired and river water substituted.

Since the paper referred to above was written, and especially in the last five years, the company has shown renewed interest in drilled wells. In 1913–'14 four wells were drilled with depths of 240, 250, 277 and 260 feet; in 1916 two, with depths of 306 and 269; in 1917 most of the wells drilled in 1899 were again brought into use; and in 1918 four wells were added which were 315, 286,308 and 317 feet in depth. The total water supply of these wells, by pumping, is estimated at 275,000–300,000 gallons in 24 hours. The casing, in most instances at least, is six-inch. The water is utilized for making acid used in the manufacture of sulphite pulp.[3]

Successful drilled wells are rather common in the slate area of southern Maine; 88 per cent. of those undertaken furnish at least a gallon a minute according to Clapp.[4] Flowing wells in slate are far less common and when struck seldom furnish over three gallons a minute.[5] Previously to the one described below none were known in Kennebec county and probably none within a radius of over 50 miles. The well 286 feet deep drilled for the Hollingsworth & Whitney Company is 1918 is therefore of special interest since it is a flowing well. A photograph furnished me shows the water flowing from a vertical six-inch casing at a height of about three feet above the ground. This flow, without pumping, was estimated to be about 60 gallons per minute; certainly, as can be seen from the photograph,

[1] "Underground Waters of Southern Maine," by Frederick G. Clapp, with records of deep wells by W. S. Bayley, Washington, 1909.

[2] *Ibid.*, 154.

[3] Data kindly furnished by Mr. George H. Marr, engineer for the Hollingsworth & Whitney Company.

[4] *Ibid.*, p. 61.

[5] *Ibid.*, p. 35.

it is far above the average given by Clapp for wells of this type in Maine. So far as I can learn, no test was made to see how far above the surface the pressure would raise the water. An interesting fact is that the 315-foot well drilled in the same year was a flowing well until the 286-well was drilled; when this began to flow, the other ceased. It would seem, therefore, that these two, at least, have a common joint plane or system of joint planes as their reservoir. This is in spite of the fact that in the later wells care was taken to space the wells a hundred feet or more apart to avoid this very thing.

Conditions adjoining these wells are such that it is not strange that an occasional flowing well should be encountered. The mills are situated on a fragment of a terrace about 80 feet above sea level. Back of them is an abrupt rise of about 80 feet to another terrace. The face of the scarp is of clay, but the slate rises through the terrace at elevations above about 160 feet. Wells drilled in the face of the scarp strike ledge after passing through 10 or 15 feet of clay showing a gradual rise of the slate underneath the terrace[6] as though marking the bank of a pre-glacial valley of more mature development. A small stream flowing down the scarp shows the same feature. This rise of the slate ledge behind the mills offers as favorable conditions as could be expected for a flowing well in a region where the reservoir consists of the joint planes of a comparatively localized area, as is generally considered to be the case in wells of this type.

It may be of interest to mention briefly a well drilled recently for the Waterville Country Club located about four miles west of those just described and in the town of Oakland. This contrasts with the Winslow wells in that it is on the summit of an almost bare slate hill 440 feet high, the highest point for several miles. Yet a well drilled here yielded a little water at 10–15 feet, and a sufficient supply at 147 feet. It was decided to continue to 150 feet, and just before reaching that depth a copious supply was encountered which rises to within 15 feet of the surface.

[6] The present course of the Kennebec River through Waterville-Winslow is between vertical slate walls.

Homer P. Little

Colby College,
Waterville, Maine

SCIENTIFIC BOOKS

Principles and Practise of Milk Hygiene. By Louis A. Klein. Philadelphia and London, J. B. Lippincott Company. 1917. Pp. 320, with 40 illustrations.

The book is intended primarily as a text for students pursuing a course in milk hygiene, but should serve a much broader purpose. It presents a well-balanced and concise résumé of facts which have an important bearing on the production of wholesome milk.

The work of others is drawn upon liberally, rather than the author's own theories and experiences, and parts of the book are replete with valuable references. The subject matter is divided into nine chapters, namely; Physiology of Milk Secretion, Colostrum, Milk, Bacteria in Milk, Milk Defects, Influence of Disease upon Milk, Dairy Farm Inspection, Pasteurization, and Methods of Examining Milk. There is also an appendix of 18 pages on Methods and Standards for the Production and distribution of Certified Milk.

A large part of Chapter VI. is given over to a discussion of tuberculosis of cows and transmission of infection to man through the milk. The theories and experimental facts leading up to the present status of the controversy are illuminating from the standpoint of completeness and organization. The hand of the veterinary pathologist may be seen in the descriptions of symptoms and pathology of bovine diseases, especially of the udder and related organs.

Chemistry and bacteriology also receive their due share of attention. The restricted emphasis put on the bacteriological methods of controlling sanitary milk production will be perhaps somewhat disappointing to those who regard the enumeration of bacteria by the direct microscopic or the plating process as of inestimable value. Correspondingly undue em-

phasis will appear to be placed on inspection, the limitations of which have in very recent years been recognized.

The book is remarkably free from grammatical and typographical error. Furthermore, the good quality of paper, the large bold type and the pleasing cover should make the book a welcome addition to the library of the dairyman, dairy inspector, milk examiner, milk distributer, public health official and others who are at all interested in the field which the author has covered.

Leo F. Rettger

SPECIAL ARTICLES

THE OVIPOSITION HABIT OF GASTROPHILUS NASALIS L.

In a short article recently published in the *Canadian Entomologist,* Vol. L., No. 7, July, 1918, pp. 246–248, entitled "Note on Oviposition of *Gasterophilus nasalis* L.," Dr. C. H. T. Townsend makes the statement that he has observed this species darting at the muzzle of a horse, leaving "whitish eggs with their sharp bases penetrating and adhering in the skin of the upper lip." Unfortunately for the proof of this observation the eggs were lost, but the author states that similar eggs were dissected from the abdomen of the fly. In the same note the author remarks that the egg of *nasalis* "is practically the same size and shape as that of *intestinalis* and that by reason of the moderately pointed anal end it is capable of penetrating tender skin." Dr. Townsend concludes that the attachment of the eggs of *nasalis* to the hairs of the host only happens inadvertently when the fly misses its true mark, namely, the tender skin of the lips.

It is not unlikely that Dr. Townsend may be capable of distinguishing the eggs of *G. hœmorrhoidalis* from those of the other two species by reason of its black color, but it is rather unfortunate that he should say that the egg of *G. nasalis* is of the same size and shape as that of *G. intestinalis.* The eggs are absolutely distinct both as regards shape and attachment to the hair, and the egg of *G. nasalis* is certainly not adapted for the penetration of the host's skin.

Far from the deposition of the eggs of *G. nasalis* on the hairs of the throat being accidental, it has been my experience that this is almost invariable. Occasionally, as many as six to eight eggs have been found on a single hair. The adult fly so far as I am aware, has never been seen to strike at the lips but always at the hairs of the skin between the mandibles and sometimes on the hairs of the cheek.

The eggs of all three species are transversely striated, a fact to which Dr. Townsend probably refers when he remarks on the transversely corrugated structure of the chorion of the egg of *G. nasalis.* But to add that these striations in the case of the latter egg serve to retain the egg in the skin after it is inserted is purely fictitious. It is undoubtedly true that the stalked egg of *G. hœmorrhoidalis* which is invariably found attached to the short hairs of the lips, often appears to penetrate the skin. Repeated examination has shown, however, that the clasping stalk may sometimes enter the hair follicle and thus give the impression that it is actually inserted in the skin.

In summing up, it is my opinion that Dr. Townsend has conceived of his ideas from observations that are quite inaccurate and that in a more detailed study of the habits of botflies he would find *nasalis* never "strikes" at the lips of the horse, and certainly in my experience it has never been known to oviposit there.

A. E. Cameron
University of Saskatchewan

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CONTENTS

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THE NEED OF CONSERVATION OF OUR VITAL AND NATURAL RESOURCES AS EMPHASIZED BY THE LESSONS OF THE WAR[1]

The great war, now ended, frightful as have been the evils it entailed on the world, should, from the standpoint of our country at least, be recognized as having brought to us an awakening in directions that will be of lasting benefit to the nation.

It has been a cheap and easy criticism to stigmatize our people as money-loving, self-centered, and materialistic, and this characterization, apparently generally held in Germany as a true picture of the people of the United States and of our national life, has, by some, even here at home, been more or less accepted as correct. The great soul of the American people, their intense patriotism and love of country, their devotion to ideals of right and of self-sacrifice and altruism, were not dormant but were hidden. We have enough of the Anglo-Saxon of our English brethren in us still not to seek to parade our better traits in boasting self-assertion—but when the time of trial and sacrifice comes, our people respond, and respond as a nation.

A marked instance of this national trait was given in our treatment of Cuba twenty years ago. It was incredible to some of our foreign critics that this country could enter into a war with Spain solely to remedy the abuses of her government of Cuba, and to free Cuba, yet the event showed that such was actually the case —and now the world recognizes that we entered into the world-war just ended, solely and only as a matter of high national duty—and with no thought of national gain in money, trade or territory, but only because we recog-

[1] Address of the Vice-President and Chairman of Section of Engineering of the American Association for the Advancement of Science, Baltimore, December 26, 1918.

nized a great duty to the fulfillment of which we must devote ourselves and to which we gave our national life and our nation's full resources.

But while our country entered on this task with no thought of gain, we have, in the accomplishment of duty, received great gain, not only in the spiritual uplift as a nation that we must feel in the realization of what as a nation we have done, but in the material benefits that have come to us from the new conditions forced by war necessities in our business life. These conditions are so many and involve such large and complex issues that they are staggering in their contemplation. Take the railroad situation alone, and consider the immense gain and enlightenment to the country resulting from the far-reaching changes in the government's attitude toward railroad management, necessitated by the war.

For years—for a generation—thoughtful and informed men have realized the want of logic and of business sense typified and enforced by national legislation in the Sherman Act and by the countless restrictive impositions of state legislatures on the proper and business-like management of our railroads—preventing pooling—forcing in the fierce competition for business the routing of freight over unnecessarily long routes—compelling absurdly low rates for service—and other restrictions generally having their incentive in political expediency rather than in careful economic study.

The public has erroneously been taught to believe that drastic uneconomic competition between our railroads, and also between our industries, should be encouraged, and indeed enforced as the law of the land, instead of the encouragement of wise economic cooperative regulation and understanding, tending to secure the best results at a minimum of waste in effort and money.

The war came—urgent war needs in transportation involving the transport of hundreds of thousands of soldiers and of enormous quantities of material, made essential cooperative management of our transportation lines. A Director-General of Railroads was appointed —and presto, in a night shall we say—all the unnecessary and vexatious restrictions on cooperative methods in our transportation systems were set aside—the government instinctively adopted business methods in the management of business enterprises, the Sherman Act was ignored, and the Interstate Commerce Commission was relegated for the time to dignified isolation and a condition of innocuous desuetude. For years the railroads had urged and shown the impossibility of keeping up their plants and equipment and of rendering due and proper service without proper and adequate remuneration in freight and passenger rates. The government, suddenly saddled with the actual responsibility of operation, and brought fact to face with a realization that the railroads it had taken over could not be run on air, brushed aside statute law and political criticism, and summarily, as a war measure, raised the charges for passenger and freight service, in reality a measure long needed in peace—and the public accepted it all—and labor benefited by increases in pay which the public was forced to provide. In industry the same lesson was enforced by the war. We were suddenly brought to an appreciation of the fact that Germany's conservation policy in her support of the practise of cooperative effort rather than that of destructive competition had built up an organization of economic strength that enabled her, from her national resources at home, without outside aid, to play the aggressive and enormously strong part she maintained up to the very end of the war.

The war has, in transportation and in national industry, taught and enforced on our nation—quick to learn—these lessons of waste in the past and of future economic management by joint cooperative effort, and of all the lessons of conservation of our resources taught by the war, those of needed cooperative effort in our railroad and industrial interests are perhaps the most prominent and important in a material sense, and the lesson has been one not only to and for the public and our national and state authorities, but one by which those interests are directly benefiting. The railroad

managers are diligently studying these problems. They are men of great experience and ability—and the chairman of their association has voiced their progress by publicly saying:

> The whole question of the ultimate return of the railroads to private operation has been considered together with the development of a system of public regulation and control for the future which shall not only protect against abuses, but be affirmatively helpful to the development of adequate transportation facilities for the great after-war tasks of the country.

While, as a war measure, the temporary possession and operation of our railroads by the government was necessary, the continuance of such a system in peace, or of any measure of government ownership with its political evils, would be a calamity depriving the traveling public of the efficient operation naturally coming from the initiative and enterprise and sense of responsibility attending individual management, and always absent where governmental red tape and autocratic authority rule, regardless of the comfort or needs of the public. Some reasonable, responsible governmental oversight or control of these great interests is without doubt necessary. The war urgency, the more intimate relations that war needs have established between governmental agencies and railroad and industrial managers, must and will lead to the establishment of systems of regulation not destructive but constructive in character, that will operate to the lasting benefit of our country.

The need of conservation and development of our latent water-power resources has been emphasized by the war. For years, since the public study of the conservation of our natural resources was initiated in 1908 by President Roosevelt's call for a conference of governors of our states to consider the matter—the National Conservation Congress, and Conservation and Forestry Associations throughout the country, have studied the problem of how best to conserve, and yet to use the country's natural resources, in water-power, and in our mines and forests. When we were brought by this war to realize our dependence on Chili for our supply of nitrates in the manufacture of ammunition, while Germany had evolved and developed economical methods of utilizing her water powers and of extracting nitrogen from the air, we were taught another lesson in conservation and of the folly of our dilatory laissez-faire system of dealing with the water problem. Under war pressure greater progress has perhaps been made than would have been possible in many years of deliberate peace methods. Serious differences of opinion have existed in the past as to the proper measure of governmental control that should be exercised in the development and use of the great latent water powers of the west, and enabling legislation has been impeded and halted by visionary and wholly unpractical objections to such reasonable and liberal legislation as would encourage capital to enter into and support such development. As a wise westerner has said of the development of the west in the past: "The western country was never settled, and never could have been settled, with thirty cents and an infant class," and conservation of our natural resources was well defined by Dr. C. W. Hayes, when chief geologist of the U. S. Geological Survey, as "utilization with a maximum efficiency and a minimum waste."

It is the use, and the avoidance of the abuse, of our natural resources, that conservation properly teaches, not the locking up of these resources. Now in this urgent, intensive war experience a broader national vision has developed. We have learned and have become accustomed to figure in billions, where we used to fear that millions would be wasteful. The government has taken hold of great questions with a giant hand, and has, by its conversion to the truth that in its conduct of great enterprises great men, experienced in the work contemplated, should be used rather than avoided with suspicion, accomplished great results—and the lesson has been enforced that when needed to attain results, large expenditures may lead to the greatest economy in methods and certainly to greater success in the attainment of ends. Our great corporations may, in view of the government's housing programs, be encouraged to feel that proper measures to that end are a necessary concomitant to the maintenance of satisfactory labor conditions, and

are an economic necessity in large and small operations.

One great lesson in conservation peculiarly applicable to our nervous, energetic, and always hard-working people, we have not yet adopted, because we are so constituted that as a nation or a race we will not learn it, is that of the better conservation of our vital resources.

The National Conservation Congress, in its several yearly sessions, has taken, among others, as subjects for study and discussion: Forestry, The Improvement of Farm Conditions, Water Powers and The Vital Resources and Health of our People. When will we learn the lessons of the last, the vital importance to our people of learning to conserve their strength. No one has better epitomized the American wastefulness of vital energy than dear old Mark Twain, who (writing from Naples in 1867), sent us these words, pregnant with the lesson of the higher conservation of life:

> We walked up and down one of the most popular streets for some time enjoying other people's comfort and wishing we could export some of it to our restless, driving, vitality-consuming marts at home. Just in this one matter lies the main charm of life in Europe—comfort. In America, we hurry, which is well; but when the day's work is done, we go on thinking of losses and gains, we plan for the morrow, we even carry our business cares to bed with us, and toss and worry over them when we ought to be restoring our racked bodies and brains with sleep. We burn up our energies with these excitements, and either die early or drop into a mean and lean old age, at a time of life they call a man's prime in Europe. When an acre of ground has produced long and well, we let it lie fallow and rest for a season; we take no man clear across the continent in the same coach in which he started; the coach is stabled somewhere on the plains and its heated machinery allowed to cool for a few days; when a razor has seen long service and refuses to hold an edge, the barber lays it aside for a few weeks and the edge comes back of its own accord. We bestow thoughtful care upon inanimate objects but none upon ourselves. What a robust people, what a nation of thinkers we might be, if we would only lay ourselves on the shelf occasionally and renew our edges.

Surely Mark was right in this.

We owe a duty of watchfulness to the men, devoted to public service, who ably lead great movements for the betterment of conditions among our people—men who are not only captains of industry, but generals in the army of public service, and leaders and exemplars in the pursuit of public duty. They become in leading these great movements, in a measure, the custodians of the public welfare, but "Quis custodiet ipsos custodes?" Who shall care for these very generals, and see that they conserve the store of intelligence, patriotism and energy, that goes out from them to public welfare, that it may not be prematurely exhausted? Surely we should take measures to have them feel how the nation values them as a public asset, and how they owe it to their country as well as to their homes to heed and to preach to others the wise words of Mark Twain.

We perhaps can not conclude that the great war has really taught us to better conserve our vital resources in our men and women, for they have been prodigal in expenditure of their strength in national service, but may we not hope that following the past one hundred years of uninterrupted peace between the English-speaking peoples of the world, the closer bond that the war has promoted between our English brethren and ourselves, while giving them a better and closer estimate of us, may bring to us a better appreciation of the value of conserving life as they conserve it, giving our nation the valued services in their advanced years of men who, under our more intensive life, would have reached their limit of usefulness.

To our engineering profession is due the early study of the doctrines of conservation, later taken up by our publicists and legislators. Conservation is primarily an engineering question. At the first, the organization meeting of the American Institute of Mining Engineers, held in May, 1871, now nearly half a century ago, which I attended, a committee was appointed "to consider and report on the

waste in coal mining" and as the whole subject of the conservation of all our resources developed and was studied, it has always been the engineers of the country, qualified by training, expert knowledge, and intelligence, who have led and must now lead in the study and broad consideration of our best national policy in conservation. It is the duty of engineers to keep in the forefront of the study and teaching of this matter, and to do their expert share towards shaping the policy of the nation to a course based on reason, economic principles and technical knowledge, rather than on sentimental or political diatribe. A greater danger is threatened to the public interests by the untrained, spasmodic, semi-political, and careless presentation and handling of these matters before the public, by men on whom their importance has suddenly dawned, than by a continuance of erroneous methods of the past. The trouble with most of the plans for railroad and business regulation, and for mineral and water-power conservation, proposed by men untrained and inexperienced in engineering and in business and financial methods and problems, is that their plans are apt to be ideal rather than real, their dicta negative and destructive rather than affirmative, positive and constructive, and their remedies untried and theoretical experiments, rather than of practical and efficient effect.

We should recognize, and this great war's awakening and upturn of all preconceived and preexisting conditions has emphasized, the importance of business-like rather than political management of our national transportation and industrial interests, and of all other national affairs involving expert scientific or business knowledge and training. Our country owes an incalculable debt of gratitude and appreciation to the great interests that have led in and made possible the wonderful transportation and industrial development of our land, and we may find that on a large scale we will be killing the goose that lays the golden egg of national prosperity, if we suffer our railroads and our great industries to be nagged and oppressed to the point of possible insolvency by blind unreasoning prejudice largely born of ignorance, and largely based on political considerations that should not control. The present agitation of the whole subject has a high educational value for our people, and we may be certain that we can in the end trust the horse-sense, the intelligence that in the long run is characteristic of our people, not to be finally led away by 'isms or wild theories, but to use in the final determination of these questions that independence of judgment and sound common sense so characteristic of and inherent in the American people, and for which our politicians so often make the mistake of not giving the people credit.

What better summary of the existing conditions following the war has or can be given than the following from the St. Louis *Star*, comprehensive in its scope, yet wonderfully succinct in its statement?

A GREATER HUMANITY RISES FROM WAR

During the process of readjustment we shall profit from the lessons the war has taught. In that, aside from freedom for all the peoples of the world, will lie the greatest achievement of the war. When the balance is struck the profit will outweigh the loss. The human lives sacrificed will yield a better and a greater humanity. The cost in dollars will be absorbed quickly in passing years. The material gains will live and produce.

We, in America, have learned something of our strength. We have learned the possibilities of our united effort. We have learned economy. We have learned concentration. These things will mold themselves into our national character. We shall act with a new inspiration. We shall feel a new confidence. We shall have a new consciousness of the invincibleness of righteous purpose.

HENRY STURGIS DRINKER
LEHIGH UNIVERSITY

CHEMISTRY AND MEDICINE: A TRIBUTE TO THE MEMORY OF JOHN HARPER LONG[1]

DR. LONG'S life and work, so ably portrayed by Professor Dains, are an eminent instance of

[1] An address given November 22, 1918, before a joint meeting of the Institute of Medicine of Chicago and the Chicago Section of the American Chemical Society.

the value of the work which lies in the great field of effort resulting from the relations of chemistry to medicine. For many years the main subjects of his investigations were enzymic action and problems of nutrition, researches of equal interest and importance to the progress of medicine and to the advancement of chemical knowledge. No less close and vital were these relations in the important spheres of influence which Dr. Long had created about himself outside of his laboratory, as instanced by his service of twenty years on the Illinois State Board of Health and by his connection with the Council of Pharmacy and Chemistry of the American Medical Association from its inception in 1905 to the end of his life. The same breadth of interest, supported by his great ability and fearless honesty, led to his selection as a member of Dr. Remsen's famous referee board, and in the last year of his life also to his election to the presidency of the Institute of Medicine of Chicago, which was founded in large measure to further the cause of medicine through the stimulation of research in all fields contributing to the advancement of medical knowledge.

Dr. Dains has discussed in an admirable fashion the details of Professor Long's valuable contributions to science and to the cause of humanity, and I have felt that I could pay no truer tribute to the high aims and achievements of my life-long colleague and friend than by attempting to outline to-night some of the important features of the relations between chemistry and medicine and thus help to have the cause "carried on" which Dr. Long so nobly served and had so greatly at heart.

From its earliest beginnings chemistry has found in medicine one of its greatest sources of inspiration—indeed, the very name of our science refers to the dawn of chemical knowledge in the temples of Egypt, the "land of Chêmi," where priests prepared simple remedies and studied their chemical nature. This close connection persisted through the centuries and found perhaps its crowning culmination in the persons of two modern giants of the medical world—the greater one, Louis Pasteur, the chemist who turning to medicine and using his chemical knowledge and its exact criteria in its service, founded the knowledge of disease through microscopic organisms, the very foundation stone of modern medicine, and the second, Paul Ehrlich, who inaugurated the present most promising era of combatting these dread causes of disease by the development of specific remedies, produced artificially in the chemical laboratory in the form of pure chemical compounds. Between these two extremes, the cause of disease and its cure, chemistry has found such an infinite variety of lines of effort contributing to medical knowledge that I must necessarily limit my subject and I shall do so by confining myself in large measure to those phases of it with which I am personally most familiar. How necessary such a limitation must be is no better shown than by the fact that at the present moment medical science seems to be turning to chemistry more and more as an essential factor in every one of its fundamental branches. That chemistry was essential in bio-chemistry and in physiology has long been well understood, but of recent years pathology also has turned to chemistry for the solution of its most important problems; the best preparation for a bacteriologist, I am told, is long and advanced training in chemistry; and even the great science of zoology, so long held in thrall by the obvious fact of form, has now turned to chemistry. How vital these applications of our science are, has been impressed most insistently perhaps on me by the the fact that some biologists seem at length to have reached the conclusion that those most important of all factors in human life, in the very evolution of our race, the factors included in the collective name of heredity, must owe their wonderful power of transmission of characters and character in final instance to the chemical nature, the specific chemical character, of chemical molecules.

With this glimpse into the vast vistas of present and future developments in the domain of the relations of chemistry to medicine, I must turn from these most alluring questions

and ask what my own chosen field of chemistry, which for the lack of a better name we still call pure chemistry, can contribute to the cause of medicine. Let me say at once that I speak almost on the defensive, I have been asked so often by eminent physicians, by physiologists and biologists of every kind, why chemistry is so intolerably slow and backward in solving what are quite obviously chemical problems—problems striking at the very root of our health and happiness. The answer very simply is this: Pure chemistry aims to be and is an *exact* science; indefinite mixtures of substances, such as our tissues and secretions represent, interest us, it is true, most deeply, but we can handle them altogether successfully only to the extent that we can isolate from them pure principles for exhaustive, *complete* investigation, so complete that we do not rest until we have dissected the molecule of the pure compound, have put it together again, and thus have acquired first hand knowledge of the exact function of each of its members. In the same way, systems that contain more variables than we can control *rigorously,* as rigorously as the mathematicians, the physicists and astronomers control their material, pure chemistry puts aside until such a time when our knowledge has advanced far enough to give us exact knowledge of each component in the system, to make possible a rigorous analysis of the whole system. Every physician knows what medicine would be without dissection, without an exact knowledge of the structure and location of the organs and members of the body—every physician knows too how the functioning of the parts in the whole can be understood only by an accurate study first of the functioning of each organ and each member. Now, the scientific dissection and reconstruction of the molecules of important isolated principles is as a rule an extraordinarily difficult problem. Thus it took Baeyer, perhaps the greatest organic chemist of his generation, some fourteen years to determine what we call the structure of indigo, containing only some thirty atoms. But, his success opened the way with the inevitableness of fate to one of man's triumphs over nature: for with the knowledge of its structure, the key was gained for the successful synthesis of indigo and its artificial preparation on a large scale, releasing many acres of land for the growth of other important products for human use. It took altogether some thirty-four years to complete the campaign for the successful production of indigo, and at that the campaign was planned and conducted by some of the keenest minds in our science and sustained by the prospects of rich rewards in gold for the successful issue! Similar vital work was carried out with other important dyes, such as alizarin or turkey red, methylene blue, magenta. I am emphasizing these facts, not only to illustrate the method of pure chemistry, but primarily to show what the successful issue of its efforts means. These and other dyes had been used commercially with an empirical knowledge during the many years that great investigators studied them from the point of view of chemistry as an exact science —but with the successful issue of their efforts in the profound analysis of the molecular structure of fundamental dyes, chemistry has gained for man supreme and practically unlimited power over the whole problem of color! It has made it possible for us to make at will a dye of any properties we may desire—fast dyes for any fabric, unstable, sensitive dyes for photography, dyes of any conceivable shade, fluorescing, if you please, with any desired hue! This instance of the power gained by chemistry has already proved to be of great value in medicine, by the development of stains to differentiate cells, microorganisms, tissues of every variety.

The lesson of this conquest of the world of color by man would be wholly lost, if you did not carry from here the conviction that the methods which have scored so brilliant a success in one field are absolutely certain to be equally successful in conquering the greater world of bio-chemistry. The methods evidently are painfully slow. It took two generations to complete the conquest of color—would ten or twelve generations be too long for the supreme conquest of the chemistry of life? The campaign has already long been

started and many a great victory is a promise of the complete triumph that must ultimately come. I shall attempt to outline for you three of the greatest problems which chemistry is facing in a titanic effort to invade and explore to its minutest parts nature's most precious domain—life: the problem of the synthetic remedy, the problem of the specific remedy, and greatest of all, the problem of living matter.

A brief survey of the development of our power to produce and control local anesthesia may serve to illustrate the kind of service chemistry is trying to render medicine in the domain of the synthetic remedy. The discovery of the effect of cocaine in removing by a simple local application all sense of pain where it has been applied, is, I believe, considered one of the great blessings of modern medicine, an aid to the surgeon, no less than a godsend to the patient. When cocaine was first exploited, there were two serious drawbacks to its use; one, its great cost—it was said to be worth its weight in gold—which necessarily limited its employment; the other, its poisonous character, by reason of which there were occasional fatalities connected with its employment. The story of the exploration of the structure of the molecule of cocaine, like that of indigo, is for the chemist a most thrilling and romantic tale—great chemists made advances, only to meet with ultimate defeat—exactly as great explorers did in the investment of the secrets of the domain of the North Pole or of the heart of Africa—until finally the penetrating genius of Richard Willstaetter succeeded in reaching the great goal. The results of these investigations are found not only in the fact that medicine has now a host of valuable substitutes for cocaine, which have powerful anesthetic properties without dangerous secondary effects but even more than the gain in materia medica is this: in the conquest of the world of color it was found that color is primarily due to certain specific groups of atoms in the molecules of dyes, or rather, vice versa, that specific combinations of a few atoms in the molecules of compounds give specific properties and functions to these compounds. This is, of course, really a fundamental law of chemistry revealed again in so complex a field as dyes. Now, exactly the same kind of *specificity* should be found in medicaments—that is, each specific function should be found to be the result of the presence of perfectly specific groups of atoms in the molecules of the medicaments. It is this application of the principles of pure chemistry which we can follow in the planned production of new and better local anesthetics and it is this application which points the way to one of the greatest lines of research for chemistry in the service of medicine—to determine by exhaustive investigation the peculiarities of an atomic group which will give the clean physiological effects which every physician would like to have at hand in the treatment of disease. The path would thus be eventually opened to a truly scientific materia medica. In the dyes we have been able to control secondary effects, such as stability or fluorescence, and we have every reason to believe that chemistry can accomplish the same results and avoid untoward secondary effects in the problem of obtaining specific physiological effects.

The tremendous development of the production of so-called synthetic remedies is the visible manifestation of the application of chemistry to the kind of research I have outlined. A large part of this manufacture of synthetic drugs is, no doubt, of no permanent value, a far too large a portion is unquestionably even detrimental to the best interests of medicine as the result of claims that are, to say the least, too sanguine and often without an adequate basis of fact. Again the lure of gold is marring while stimulating this great effort in behalf of mankind. But that real progress has been made has been amply demonstrated by the situation in this country in the matter of synthetic drugs, resulting from our war with Germany: this has separated the wheat from the chaff and shown that there indeed are a number of drugs, invented by chemistry, which may be considered vital in the treatment of disease.

The second line of research in the application of these methods of chemistry to the prob-

lems of medicine, which should be emphasized, is that which has found its most convincing expression in Ehrlich's great work on salvarsan and neo-salvarsan, now known to us by their American official names as arsphenamine and neo-arsphenamine. This is the most convincing instance of the wonderful opportunities in developing the specific agent that will kill a specific invading germ without permanent injury to its host. Quinine was, I believe, the first specific of this kind, and it would seem that it would have been only a single self-understood step from the use of a natural chemical compound to the development of synthetic chemicals for similar purposes—but it took an Ehrlich to take the first great and successful step in that direction. Ehrlich, like Pasteur, was a chemist before he became interested in medicine and it is important to know that in developing arsphenamine he used all the resources of pure organic chemistry, his special field, changing the structure of the molecule he was developing, here a little, there a little, putting an apparently slight but essential finishing touch here and there, just as a sculptor would handle his clay and his marble. Finally after six hundred and five preliminary studies the product needed to produce the desired effect was perfected! In arsphenamine the ordinary path of synthesis was abandoned, that is, the ordinary path of taking a natural product like indigo, cocaine, or atropine and finding out the secret of the constellation nature had constructed. Ehrlich struck out to build his own cunning molecular contrivance to kill the invading germ without harm to the host and he succeeded brilliantly! For many other diseases due to bacterial invasion medicine is now using specific antitoxins and vaccines, manufactured in some host or medium by the germs themselves. With the curative agency we find inevitably substances poured into our systems which are not needed for the effect desired and which may indeed be harmful. For instance, a child unfortunate enough to have received a prophylactic dose of diphtheria antitoxin is exposed to the dangers of anaphylactic shock if later an actual attack of diphtheria develops and the treatment with antitoxin is indicated in an effort to save its life. Surely, physicians would prefer to use some pure specific if chemistry could prepare one, equally efficient, equally potent. The effort to prepare such chemical specifics has been blazed by the discovery of arsphenamine and invites untiring research efforts on the part of chemists. Some of the other synthetic drugs which have already been prepared are specifics, if not in the sense of completely curative agents, at least as alleviating remedies of the highest value. The demands for luminal for the relief of epileptics, which have come in since its importation was stopped by the war have been pathetic in the extreme, and the gouty sufferer on the other hand has been grateful that almost without any delay American chemists were able to produce phenyl cinchoninic acid or atophan, which clears the system of the ache-producing uric acid!

We now come to the third and last field of effort of pure chemical research in the service of medicine which I should like to include in this short sketch—the study of the chemistry of life itself, of protoplasmic agencies and activities. Such a study is clearly so fundamental that it must ultimately give the world the rational basis both for preventive and for curative medicine. The problem obviously is a tremendous one that must be attacked by many workers from many sides and it will take generations of toilers to complete the great undertaking. That complete knowledge will come no one can doubt who has followed the brilliant advances made in the last sixty years. At this time I can refer only to a very few phases of this slow but triumphant march of our science to the knowledge of the chemistry of life—a few phases which illustrate different lines of attack and which at the present moment hold out the greatest promise of success.

First, let me recall the fact that Pasteur's first great contribution to science, as a young chemist of twenty-six, was the discovery in a study of the crystalline character of tartaric acid, that matter may be arranged in molecules in space in an unsymmetric fashion, yielding

distinct forms, which have in the simplest cases the same relations to each other as my right hand bears to my left, and that shortly after, he made the remarkable discovery that living matter discriminates sharply between two such forms, which are identical in every particular except that the one is the optical image of the other. Thus, he found that dextro-tartaric acid is destroyed by ferments, lævo-tartaric acid is not. It is of interest to mention, in passing, that this very discovery, arising out of pure chemical researches, was the fortunate incident in Pasteur's life that drew his attention to fermentation and opened the path to his great work on the germ theory of disease, to which medicine owes its present strength.

The mode of attack used by pure chemistry is to isolate pure compounds and study them exhaustively, both as to structure and as to their chemical activities. In attacking the problem of protoplasm we must isolate such of its components as we can, the materials it uses as food, the materials it excretes, and study each exhaustively. Thus, another great leader in this field, Emil Fischer, has laid the foundation of the chemistry of carbohydrates by his brilliant studies of the monosaccharides. How important these studies are for the science of protoplasmic activity is shown by the fact that of the sixteen stereoisomeric aldehyde-hexoses, differing only in the space arrangements of the atoms in their molecules, only three, d-glucose, d-mannose, d-galactose, are directly fermentable! Fischer, again, in his classical researches on the amino-acids and the polypeptids has been laying another broad and sure foundation for the study of the ultimate chemistry of the proteins. It is characteristic of the greatness and thoroughness—and the slowness—of the methods of pure chemistry that this study of the chemistry of proteins is growing in the same way that a magnificent monument would be erected. It is well-known that any one of the beautiful cathedrals of Europe was constructed as a rule not in one generation and by one architect, but rather slowly grew as the product of the efforts of succeeding generations, of the genius of successive architects. We see now only the foundations of the monument of the chemistry of the proteins, laid with painstaking accuracy, by workers in all countries. None of us will live to see the completion of the monument in all of its glory, but those who best understand the work have a supreme faith in the ultimate realization of their vision—and with it must come an insight into the nature of protoplasm and of life which no other study can hold out to us in like measure.

What a wealth of problems lies ready for the bold investigator! We may think of the isolation and exhaustive study of the active principles of the secretions of the internal glands, on whose presence in balanced proportions our healthy existence depends in so large a measure. Suprarenin or adrenalin has already been isolated by our American Abel and prepared artificially by the Germans, Stolz and Flaecher. The active principle of the thyroid gland has been isolated by E. C. Kendall of the Mayo Laboratories and found so potent, that an unbelievably minute amount injected into patients makes the difference between disease and health. Dr. McCollum is closing in on the secret of the active principles in our food commonly called the vitamins: should they prove to be organic and not vital mineral components, a study of their chemical nature and the structure of their molecules would follow, and what a triumph for humanity if we could then produce them from waste products like coal-tar and help out the fast decreasing ratio between supply and demand of dairy and similar products in crowded populations! You men of medicine do use organs of animals, ground or extracted, to make good a deficiency in this or that secretion in disease, but how much greater would your confidence in your therapy be if in place of mixtures of uncertain potency, pure chemical products were at your disposal. It is not so long since you used to employ your most important specific alkaloids in the same uncertain way, but what modern doctor would now hesitate in his choice between strychnine and nux vomica, atropin and belladonna, morphine and opium! Moreover, the isolation of

the pure alkaloids by the chemist has put into your hands the swift weapon of intravenous injection and the same promise is held out for the pure isolated principles of glands.

Isolating and investigating pure principles of food, of excretion, of physiological secretion, even to the point of the structure of their molecules, is a great and important task of pure chemistry, but it deals with only half of the great problem. Life is dynamic, it is material *in action,* and hence there is another great side to the problem of the chemistry of life, namely, the relations of the laws of chemical action to life. Every advance in our studies in physical chemistry, the branch of chemistry in which we study chemical dynamics, has found its important reflection, often its immediate reflection in its applications to life phenomena. Thus, the principle of the conservation of energy in chemical changes forms the basis of a large and vital part of the work on food values and their relation to proper sustenance. Then, we have the applications of the laws of solutions and of the theory of ionization in the use of saline injections, in the problems of fertilization as studied by Loeb, in the study of the regulation of the heart beat. We have the application of the laws of reversibility and equilibrium by Hill and by Emmerling to demonstrate the reversibility of enzymic action and thus to account in some measure for the synthetic processes of protoplasm, without which life would be impossible. The studies of the laws of catalysis or acceleration of action is another study fundamental for the understanding of life, for, as Ostwald has said, our bodies are wonderfully controlled machines in respect to that fundamental factor of nature, the *time* factor. I need not emphasize the significance of the time factor in medicine, for we all know that health and disease are distinguished in no way more characteristically than by such time factors as heart-beat, respiration, rate of growth, rate of elimination, of decay. Our time controlling devices are essentially the catalyzing enzymes and the investigations of their mode of action, of their production and control in the body belong to the most important ones in medicine. Such diseases of nutrition as gout and diabetes are most likely the result of abnormalities of enzyme supply.

How rapidly a discovery in physical chemistry may find its application in the study of life activities is well illustrated by this instance: Professor Wilder D. Bancroft at Cornell University a few years ago made some extremely interesting observations connecting emulsions of oil in an aqueous medium with the presence of sodium and calcium oleates in the medium of the emulsion. By varying the ratios he could produce at will an emulsion of oil in the aqueous liquid or an emulsion of the water fluid in the oil. These genial observations were hardly published when Dr. Clowes, of Buffalo, applied their principles successfully to such problems as the clotting of blood, the coagulation of milk, the chemical fertilization of eggs, à la Loeb, and to anesthesia! This work is a brilliant instance of the rôle played by colloid chemistry, the chemistry of colloid dispersions, in life phenomena. Since the major part of our bodies is a complex aggregation of colloid systems and since every particle of protoplasm is itself a colloid, the importance of this side of chemistry for the study of life can not be overestimated.

It is evident, therefore, that all phases of physical chemistry as well as the analytical and synthetical sides of pure chemistry are finding vast fields of investigation for chemists in the domain of medicine and its fundamental sciences, fields drawing to themselves ever increasing numbers of ardent workers. The friend and collaborator whose memory we are cherishing to-night was himself an indefatigable worker in this great cause, whose ultimate goal is a complete and masterful knowledge of the science of living matter. We can in no way pay greater tribute to his memory and devoted career than to pledge ourselves anew to continue our own modest efforts toward the upbuilding of this monumental undertaking of man's courage and genius, although we well know that only fu-

ture generations will see the glories of the completed monument!

Julius Stieglitz
The University of Chicago,
Chicago,
November 22, 1918

EDUCATIONAL EVENTS

BIOLOGICAL SURVEYS OF STATES BY THE UNITED STATES DEPARTMENT OF AGRICULTURE

Natural history surveys, dealing with the geographical distribution, habits and relations to environment of birds and mammals, with particular reference to the utility of the information gathered to the proper solution of problems in game protection, public health, forestry, grazing and agricultural practise, were carried forward in several states by the United States Biological Survey, Department of Agriculture, and cooperating institutions during the field season of 1918.

In Wisconsin the work of the Biological Survey was conducted, as since the beginning of investigations in that state, with the cooperation of the Wisconsin Geological and Natural History Survey, of which Dr. E. A. Birge is director. The personnel of the field party operating during the season included Dr. Hartley H. T. Jackson, Biological Survey, in personal charge; Mr. A. J. Poole, U. S. National Museum, as his temporary assistant, for the Wisconsin Survey, and Mr. A. I. Ortenburger, temporary assistant Professor George Wagner, of the University of Wisconsin, administers the interests of the Wisconsin Survey in the undertaking. Investigations were made in the distribution and habits of mammals, birds, reptiles and amphibians, the greater portion of the season being devoted to the upper Wisconsin River valley.

In central Montana Mr. M. A. Hanna, temporary field assistant, prosecuted the work under the direction of Mr. Edward A. Preble. This is the third consecutive season of field work in Montana, during which the southern half of the state east of the mountains has been covered.

A biological survey of Florida was undertaken by Mr. Arthur H. Howell, with Mr. Charles H. M. Barrett as field assistant for a part of the time. Investigations were made chiefly in the southern part of the state from Lake Okeechobee to Cape Sable and on the west coast from Sarasota Bay northward to Homosassa. Special attention was given to the fauna of the Royal Palm State Park, in the southern Everglades near Homestead.

Field investigations in Arizona in general charge of Mr. E. A. Goldman, now in France as a major in the Sanitary Corps, have been conducted over several seasons, being carried forward during the past summer in extreme southwestern Arizona by Mr. A. Brazier Howell, of California. There is left still unworked the southeastern portion only of the state.

Surveys of New Mexico, North Dakota and Oregon have recently been completed under the general direction of Mr. Vernon Bailey. Reports on the mammals, birds and life zones of these states are completed or in various stages of preparation.

Work in Washington was performed in informal cooperation with the State College of Washington, Pullman, and the State Normal School, Cheney. The personnel of the field parties operating included: Biological Survey, Dr. Walter P. Taylor, in charge, assisted by Mr. George G. Cantwell, reservation inspector, and for a short time by Mr. Stanley G. Jewett, predatory animal inspector; State College of Washington, Professor William T. Shaw, in charge, assisted by Mr. O. H. Homme, temporary field assistant; State Normal School, Cheney, Professor J. W. Hungate. During the two consecutive seasons involved investigations have been carried forward in the southern Cascades, along the Columbia River, in a broad belt across the state from Spokane to Puget Sound, and in southwestern Washington. Mr. Cantwell is continuing the work through the fall and winter months.

THE CENSUS BUREAU

According to the annual report of Director Rogers, of the Bureau of the Census, the

Census Bureau during 1918 directed a part of its energies to the compilation of war statistics. The increase in this class of work was so large that the number of employees engaged on it rose from 92 on July 1, 1918, to 231 on September 1.

The war work done by the bureau covers a wide range. Its more important phases include canvasses of manufacturers and dealers to ascertain the consumption and stocks on hand of certain raw materials used in war industries, and the production and stocks on hand of commodities made therefrom; the classification of occupations of military registrants, an undertaking that necessitated the handling and rehandling of more than 8,000,000 cards; estimates of population for use as a basis in the apportionment of the first draft; the allocation of enlistments; and the determination of registrants' ages from census records. In addition to carrying on these and other specific lines of work at the request of the war agencies of the government, the bureau has complied with many requests for information which had a bearing on the problems arising in connection with the war.

During the fiscal year the bureau carried on 13 regular and 7 special lines of work, in addition to the war work and the preparations for the Fourteenth Census. The regular inquiries included canvasses of water transportation and shipbuilding, of electrical industries, of religious bodies, of births and deaths, of state and municipal finance of cotton and cotton seed, and of stocks of leaf tobacco in the hands of manufacturers and dealers.

The work on birth and death statistics has been considerably expanded during recent years. These statistics are gathered only from those states and municipalities which maintain adequate registration systems.

The special work done by the bureau included a census of the Virgin Islands recently purchased from Denmark. These islands have a total area of 132 square miles, and the total population on November 1, 1917, was 20,051.

Another special line of work undertaken by the bureau was the tabulation of data covering the disputed areas of Europe and Africa—that is, those areas whose final disposition will be determined by the outcome of the war.

The force of the Census Bureau in Washington comprises 684 officials and employees, and in addition there are employed throughout the cotton belt approximately 700 local special agents who make periodical collections of cotton and cottonseed statistics.

In order to avoid waste and delay in the conduct of the next decennial inventory of the country's population, agriculture and industries, to be made in 1920, the bureau is carrying on such preparatory work as can be done prior to the enactment of the pending bill to provide for the Fourteenth Census. Under this bill, if it is enacted into law, all the clerical and subclerical force of the bureau will be appointed through open competitive examinations, held by the United States Civil Service Commission, as at the census of 1910.

The Fourteenth Census will cover the subjects of population; agriculture, including irrigation and drainage; manufactures; and mines, quarries and oil and gas wells. The undertaking will require the services of a field force of about 85,000 or 90,000, chiefly enumerators.

THE BUREAU OF STANDARDS

THE annual report for 1918 of Dr. Samuel W. Stratton, director of the Bureau of Standards, reports that the regular work of the bureau has yielded important results. Apart from new researches, a large volume of testing was completed, more than 300,000 separate tests being made. The construction of the new industrial laboratory, the completion of the metallurgical laboratory, and the building of a number of emergency war laboratories for airplane investigations were events of interest, and will be of great value in the development of the several branches of technology within the bureau's field.

When the United States entered the war, the bureau already possessed exceptional facilities, equipment, and personnel, chemistry and engi-

neering. This enabled it to take up promptly many important military researches. The laboratories, so useful during peace, proved of especial importance in war. The specialized equipment of instruments, materials and supplies were on hand which were then almost unobtainable elsewhere. The bureau promptly extended its service to all lines of scientific work which would assist in the war. Practically every section of its regular organization has had military problems of the most pressing nature submitted to it, and invaluable service has been rendered.

The recent expansion of the bureau has been on lines vital to the success of the war. It is interesting to note, however, that many of these lines are also of essential value to our industries in peace. The need for the national provision for master-gauge standardization was only realized by those in close touch with such work. The accurate dimensioning of the functioning parts of mechanisms will permit extending the American system of manufacturing interchangeable parts to its maximum usefulness. The importance of nation-wide standardization has long been known, but the practical working out of such standardization is best met by a national laboratory such as the Bureau of Standards. The same principle holds for all the technologies and special branches of physics.

The combination of pure science and technology has proved especially stimulating and effective. The close cooperation of physicists and engineers in practical as well as theoretical work has given an unusual breadth to such researches. In turn, the technologic facilities have proved of great value in the purely scientific work. Many cases might be cited where the elements of a research problem ramify into laboratories of practically every division of the bureau. The airplane is an example, and a problem apparently as simple as the spark plug has called for researches in many different technical sections of the bureau. The establishment of new industries in America, such as those of optical glass and chemical porcelain, and the scientific remodeling of older industries are fruits of the more intimate cooperation of science and industry which it is the function of the bureau to promote.

A fine laboratory for industrial research is nearly completed and will be ready for use in a few months. This laboratory, when completely equipped, will be one of the most effective of its kind in the world. In no national institution in the world is the union between pure science and practical technology so intimate as in the work of the Bureau of Standards.

Apart from confidential reports the bureau published during the year about 50 new publications, including scientific and technologic circulars and bulletins. Thirty-six confidential circulars were printed on the subject of aviation instruments alone. The establishment of the work on metals in a suitable laboratory building was followed by the establishment of experimental foundry and other research work on a practical basis. An interesting branch of the bureau's work is found in the field of public utilities, especially recent developments in regard to telephone service standards, and the standards of safety practise for power service, elevator service, crane construction, building construction, and the like.

SCIENTIFIC NOTES AND NEWS

Professor Edward M. East was elected president of the American Society of Naturalists at the recent Baltimore meeting.

Dr. C. M. Child, professor at the University of Chicago, has been elected president of the American Society of Zoologists.

Mr. Robert T. Jackson, of Peterborough, N. H., has been elected president of the Paleontological Society.

Dr. F. E. Wright, of the Geophysical Laboratory of the Carnegie Institution, has been elected president of the Optical Society of America.

The Society of American Foresters have elected the following officers for 1919: *President,* F. E. Olmsted; *Vice-president,* W. W.

Ashe; *Secretary,* P. D. Kelleter; *Treasurer,* A. F. Hawes; *Member of the Council for Five Years,* S. T. Dana.

AT the annual election for officers and councillors of the American Philosophical Society held on January 3, the following officers were elected: *President,* William B. Scott; *Vice-presidents,* George Ellery Hale, Arthur A. Noyes, Hampton L. Carson; *Secretaries,* I. Minis Hays, Arthur W. Goodspeed, Harry F. Keller, Bradley Moore Davis; *Curators,* Charles L. Doolittle, William P. Wilson, Leslie W. Miller; *Treasurer,* Henry La Barre Jayne; *Councillors,* to serve for three years, Maurice Bloomfield, John M. Clarke, George H. Parker, Arthur G. Webster.

THE officers of the American Public Health Association elected at the Chicago meeting are: *President,* Lee K. Frankel, New York City; *Vice-presidents,* Colonel John W. S. McCullough, Toronto, Ont.; Colonel Victor C. Vaughan, Ann Arbor, Mich., and Dr. John D. Robertson, Chicago; *Secretary,* A. W. Hedrick, Boston; *Treasurer,* Dr. Guilford H. Sumner, Des Moines, Iowa, and *Executive Committee,* Drs. Allan J .McLaughlin, U. S. P. H. S., Washington, D. C.; Charles J. C. O. Hastings, Toronto; Peter H. Bryce, Ottawa; John N. Hurty, Indianapolis, Ind., and William C. Woodward, Boston. The association will meet next year in New Orleans.

THE Perkin medal of the American Chemical Society has been awarded to Dr. F. G. Cottrell, of the U. S. Bureau of Mines, for his work on electrical precipitation.

DR. LIVINGSTON FARRAND, president of the University of Colorado and of the Rockefeller Anti-tuberculosis Commission, has been named an officer of the Legion of Honor on the proposal of Captain André Tardieu, French high commissioner to the United States. Selskar M. Gunn, of Boston, and Alexander Miller, have been made knights of the Legion of Honor.

CAMBRIDGE UNIVERSITY has conferred on Mr. F. W. Harmer the titular degree of M.A., *honoris causa.* Mr. Harmer, who is eighty-four years of age, served the office of mayor of Norwich about twenty-four years ago. The degree was granted in recognition of researches in geology, especially that of the eastern counties, which have occupied his chief attention for more than fifty years.

DR. FRANK M. SURFACE, of the Maine Agricultural Experiment Station, who has been in Washington for the past year and a half as assistant chief of the Statistical Division of the U. S. Food Administration, sailed for France in December 31 as Food Statistician of the American Commission to Negotiate Peace.

IT is reported that Brigadier Generals J. M. T. Finney and W. S. Thayer have been ordered back to the United States from France.

MAJOR WILLIAM A. HAMOR, Chemical Warfare Service, who returned from France in November, after ten months' service in the American Expeditionary Forces, has resumed his work at the Mellon Institute of Industrial Research as assistant director. Major Hamor served as assistant chief of the Technical Division of the Chemical Warfare Service until the conclusion of hostilities.

PROFESSOR F. C. NEWCOMBE, of the University of Michigan, has been granted leave of absence for the second half year on condition that he supply a substitute at his own cost.

DR. R. W. HESS, formerly chemist in the dyestuff department at the Chicago plant of the Sherwin-Williams Co., has recently accepted a position as senior research chemist with the National Aniline and Chemical Co., Buffalo, N. Y.

DR. WILLIAM V. P. GARRETSON has recently been appointed consulting neurologist to the Hospital of Functional Reeducation of Disabled Soldiers and Sailors, which is affiliated with Cornell Medical College, New York.

THE annual meeting of the Philosophical Society of Washington was held on January 4. The address of the retiring president was given by Dr. George K. Burgess on "Science and the after-war period."

THE inaugural address of the Listerian Society of King's College Hospital, London, was given by Sir St. Clair Thomson, who described

the advent of Lord Lister to King's College Hospital in 1877.

Dr. Rossiter Worthington Raymond, the well-known mining engineer, died on December 31 aged seventy-eight years.

The Journal of Industrial and Engineering Chemistry reports the deaths of Dr. Harry Percival Corliss, until recently an industrial fellow in the Mellon Institute of Industrial Research, University of Pittsburgh, at Ray, Arizona, on November 16, of pneumonia following influenza at the age of thirty-two years, and of Dr. Frank Amon, who had also been connected with the Mellon Institute as research fellow for some months and who had enlisted in the U. S. Gas Defense work in 1917. Dr. Amon died of pneumonia, at Souilly, France, on October 12.

Professor Golden, emeritus professor of practical mechanics in Purdue University, and since 1884 a member of the faculty, died on December 18, aged fifty-eight years.

Dr. Reginald Percy Cockin, assistant helminthologist of the London School of Tropical Medicine died on December 9 in his fortieth year.

The death is announced at the age of fifty-four years of Dr. Gustave Bouchardat, professeur agrégé in the Paris medical faculty and honorary professor in the school of pharmacy. Dr. Bouchardat has been a member of the Académie de Médecine, section of physical and medical chemistry, since 1882.

The medical college in Peking, China, under the auspices of the Rockefeller Foundation, which is now under construction, will cost $6,000,000, and will be open in 1920. Eighteen university buildings, forty faculty residences and a hospital with 200 beds will be constructed. A medical school will also be established at Shanghai and subsidiary medical stations will be established throughout China. Subsidies will be granted to existing missionary hospitals which will be standardized and will offer internships for the university. The work will require a total expenditure of $10,000,000 with an additional $250,000 to $500,000 annually for support.

Mr. P. W. Sprague, of Boston, has given farming lands to the Maine Agricultural and Industrial League to conduct as it sees fit. It is to be known as the league's demonstration farm. The property consists of five distinct farms, which have a total of more than 1,000 acres of land. On each farm is a set of buildings occupied by the families of the superintendent and caretakers.

The honorary treasurers of the Ramsay Memorial Fund announce that it is now just over £40,000. The aim of the appeal was £100,000. There are still a number of contributions to be received from the overseas committees which are collecting contributions. The Million Shilling Fund, opened by a donation of 1,000 shillings by the Prince of Wales, now totals over 58,000 shillings.

Announcement is made by the Association of the Alumni of the College of Physicians and Surgeons in the City of New York of its biennial Cartwright Prize of $500 to be awarded at commencement, 1919. Competitive essays, which must contain records of original investigations made by the writer, must be presented on or before April 1, 1919, typewritten in English and accompanied by the usual safeguarding device or motto.

The London *Times* calls attention to the serious effects of the influenza epidemic in India. In Bombay city there were 15,000 deaths, and in Delhi city, in a population of 200,000 the death-rate at one time reached 800 daily. In the rural tracts beyond the reach of effective prophylactic measures the loss has been tremendous. A recent report shows that in the Punjab it followed much the same course as in places attracting more public notice. The first signs appeared in August. In September it persisted in a mild form, and from the middle of October until November 8 it was acute. It is estimated that the number of deaths ranges from 5 to 10 per cent. of the population. The death-roll is heaviest amongst young adults and women. The number of deaths in the Punjab is estimated at 250,000. When the final results of the epidemic are summed up it will probably be

found that other provinces have suffered on approximately the same scale. No part of the country seems to have escaped, although the visitation was lightest in Bengal, and even the dry and bracing Himalayan tracts are reported to have been severely attacked. The population of the Punjab and the Punjab native states is about 24,000,000, and of the whole of India about 315,000,000. If the influenza death-rate proves as heavy throughout India as in the Punjab, this would give a total death-roll of over 3,000,000. It is planned to establish a Medical Research Institute in Bombay on the lines of the Rockefeller Institute to which large donations have already been promised.

THE library of the Rothamstead Experimental Station in England has received a check for £300 from the Carnegie Trust, for the purchase of important reference books. This is the second gift made by the Carnegie trustees to the library, a check for a like amount having been given two years ago. The object is to afford agricultural students and experts using the library the opportunity of consulting the most recent and most important treatises on agriculture and allied sciences. Two valuable gifts have also been received from Captain the Hon. Rupert Guinness. The library is fortunate in possessing an unusually good collection of early printed books on agriculture of the fifteenth and sixteenth and seventeenth centuries; to these Captain Guinness has now added perfect and beautiful copies of the first and second printed books on the subject—namely, the volume on agriculture by Crescentius, printed in 1471 at Augsburg, and Jensen's edition of the Latin agricultural writers, printed at Venice in 1472.

UNIVERSITY AND EDUCATIONAL NEWS

AN anonymous donor has agreed to pay over to the corporation treasurer of Vassar College dollar for dollar up to $150,000 provided a like amount was paid or pledged by the alumnæ not later than February 28, 1919.

PACIFIC COLLEGE at Newberg, Oregon, has received an addition of $15,000 to its endowment fund from the estate of Mary E. Mann.

THE faculty of medicine of Western University, London, Ont., is planning the erection of a new medical college building at an estimated cost of $100,000.

MEDICAL colleges have been organized in the military zone in France to be attended by military men and to teach military medicine. One of these colleges will be near Rheims where there are already 3,000 beds and 70 students. The curriculum comprises surgery, medicine, histology and medical physics.

THE school of chemistry of the University of Pittsburgh announces the following additions to its staff: Dr. Alexander Lowy, assistant professor of organic chemistry; Mr. Leon E. Jenks, assistant professor of analytical chemistry; Mr. Blaine B. Westcott, instructor in organic chemistry.

ASSISTANT PROFESSOR LEE IRVING KNIGHT, of the department of botany at the University of Chicago, has been appointed plant physiologist in the division of plant pathology at the Minnesota experiment station.

PROFESSOR HILTON IRA JONES has been elected head of the department of chemistry at the Oklahoma Agricultural and Mechanical College to succeed Dr. L. Chas. Raiford, who becomes associate professor of organic chemistry in the University of Iowa. Dr. Jones was formerly head of the department of chemistry at Dakota Wesleyan University, Mitchell, South Dakota.

DISCUSSION AND CORRESPONDENCE

TWO NEW INSTANCES OF POLYEMBRYONY AMONG THE ENCYRTIDÆ

DR. RAFFAELLE SARRA has recently published at Portici, Italy, two important papers, author's extras of which have just reached Washington. They are from the *Bulletin* of the Laboratory of General and Agricultural Zoology of the Superior School of Agriculture at Portici, Vols. X., and XII., and are entitled "Osservazioni Biologiche sull' Anarsia lineatella Z. dannosa al frutto del mandorlo" and

"La Variegana (*Olethreútes variegána Hb*) ed I Suoi Parassiti." The observations to which especial attention should be called in this connection are likely to be unnoticed by students of polyembryony, and this especial note is therefore written.

One of the parasites of *Anarsia lineatella* is *Encyrtus variicornis* Nees, a species not known to the present writer, but which was retained in the genus *Encyrtus* by Gustav Mayr in his monograph of the European Encyrtidæ. The only previous record of its rearing seems to have been by Nees, from a cell of *Eumenes coarctata,* and it now appears from the observations of Sarra that it is altogether likely that Nees's specimen came not from the larva of the Eumenes but from some lepidopterous larva stored in the cell.

Sarra finds that the female parasite lays eggs in the egg of the *Anarsia*; that the parasite egg gives origin to a number of larvæ which live within the larva of the *Anarsia* after it has hatched, in just the same way as do the other related larvæ as studied by Marchal and Silvestri.

The second case is that of an unnamed species of *Copidosoma* reared from the larva of *Olethreútes variegana.* Here too, the parasite eggs are laid in the egs of the *Olethreutes* and develop in its larvæ, 68 females and 80 males being reared from a single host larva.

These observations are of interest not only as adding two species to the list of polyembryonic forms, but, since *Encyrtus variicornis* has not previously been associated with the *Copidosoma* and *Leptomastix* group of *Encyrtidæ,* another genus is added to the list.

L. O. Howard

FOUNDATIONS OF MECHANICS

In a communication to Science of October 4, I used the term "doctrinal function" in the sense of a consistent body of postulates and theorems containing one or more undefined elements, but considered apart from any of the various interpretations that could be placed on the undefined elements. The introduction of this useful term "doctrinal function" was erroneously attributed to Bertrand Russell. It should have been attributed to Professor C. J. Keyser[1] who is the originator.

With reference to the criticisms by Professor Franklin and MacNutt, in Science of November 8, of my communication of October 4, I do not merge "identification" and "measurement," in the paper mentioned, but state that I think the distinction between them valueless in the context referred to. So far as the relation between mass and force is concerned, I was merely following Messrs. Franklin and MacNutt's words: "We prefer to define mass *quantitatively* (italics mine) in terms of the operation of weighing by a balance scale." Nothing other than a quantitative definition would be of value in the equation $f/a = m$.

The fundamentally defining quantities need not be the same as those kept by the Bureau of Standards. Temperature—the real temperature—is defined by Carnot engines, but they do not keep Carnot engines in the Washington bureau. Chemical affinity as measured with the help of a Weston standard cell is another example of the same thing. The verification comes from the totality of physical experience. "An experiment," says Duhem,[2] can never condemn (or validate) an isolated hypothesis but only a doctrine (*ensemble théorique.*"

Of course, there are other kinds of physics besides force physics, and it would be erroneous to say that any of the discussions exhausted all there is in the ideas of force, mass, etc.

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TROPICAL ENERVATION

The opinion is widespread, in northern climes, that a continuously warm climate, unbroken by sharp periodic changes, is ennervat-

[1] See Keyser, "Human Worth of Rigorous Thinking," p. 254, and "Doctrinal Functions," *Jour. of Philos., Psychol. and Sci. Methods,* Vol. XV., p. 262.

[2] "La Théorie physique," Paris, 1906.

ing and detrimental to the white man. This opinion is substantiated by a considerable variety of evidence. Under tropical or subtropic conditions the white man, according to this theory, can not do the same amount of sustained physical or intellectual work that he accomplishes in a cold climate.

The present paper will not attempt to controvert in full this theory of tropical "enervation," but merely aims to present conditions in the Hawaiian Islands as a specific instance to the contrary. The writer has resided in Hawaii for eleven years; his three children have been born there; and he has been much interested in the physiological relations of climate.

Hawaii, in the North Pacific Ocean, is subtropical. It is free from the intense humidity and heat of equatorial regions, and is cooled by trade winds that blow steadily from the northeast during most of the year. On the lowlands, where the entire population (250,000) resides, the annual thermal range is between 57° and 88° F., averaging 73° F. Honolulu, the only city in the islands (70,000 population), has an annual rainfall of about 42 inches, and a thermal range from 65° F. to 82° F.; mean temperature, 73° F.

The significant fact, which the writer wishes to strongly emphasize, is that the "white" population lives "American style," and differing in *no essential* from the mode of living customary in any northern city on the mainland. Habitation, clothing and food are essentially the same as one would find in the same class of society in Duluth, Winnipeg, Buffalo, Halifax, New York or Boston. The houses, of course, are not heated, and are somewhat more open and airy than are cold-climate houses. Otherwise they look like the houses in any American city. Summer-weight clothing, eastern style, is worn the year round. Americans wear exactly the same styles as in the eastern states. Most of the food is imported from the mainland.

The hours of labor for business men, professional men and laborers are just as long as in northern regions. The holidays and vacation periods are no more numerous. The lunch period is one hour, at noon, and there is no siesta. Agricultural laborers (mostly Orientals; some Caucasians, ex-Spanish and Portuguese) work in the fields the year round, with no winter rest period.

The American banker, doctor, lawyer, merchant works just as long and as diligently in Hawaii as he would or does in any northern city. A white laboring class does not exist in Hawaii. This is due, however, not to climatic conditions, but to the economic competition of cheap Oriental labor. In early days, before Hawaii was flooded with low-wage yellow labor, white men worked in the fields successfully, and with no evidence of physical deterioration.

White pupils in the public and private schools progress through the elementary, secondary and collegiate grades at the same rate as in cold climates; have essentially the same curriculum; do the same amount of study; and carry on the same kinds of recreation and athletics. Young men and women, born and educated in Hawaii, who have gone to the mainland schools (Wellesley, Vassar, Cornell, Stanford, Yale, Harvard, etc.), not only take equal rank with the other students there, but in many notable instances have shown unusual scholarship, leadership and athletic ability. White children growing up in Hawaii have much more outdoor life throughout the year than do the majority of cold-climate children. There are no Hawaiian diseases of infancy or childhood differing from those of other countries. The salubrious climate is extremely conducive to healthy infancy and childhood.

It must be acknowledged that the change from a northern to a subtropical climate does not always agree with the white woman. Some suffer from poor health, and more or less profound functional derangement. In many cases lactation is inadequate, or abnormal in other ways. A large percentage of white babies in Hawaii are bottle-fed. However, the problem is an open one, as to how much of the ill health of some white women in Hawaii is directly due to climatic maladaption, and

how largely due to other causes. White women in Hawaii represent a highly selected class—the wives and families of capitalistic and professional classes. Many white women in Hawaii have enjoyed excellent health, have raised large families of stalwart children, and have lived to ripe old age.

On the whole, there is little evidence of tropical "enervation" or lassitude among the white population of the Hawaiian Islands. In high moral, intellectual and physical life, tone and labors, this population compares most favorably with similar groups in any northern climate. In spiritual leadership, in literary and artistic productivity, in scientific and technical research, in financial and business organization and development, in agricultural exploitation, in sport and athletics—in fact, in every notable manifestation of the human mind and body, the white man in Hawaii has achieved remarkable success. He shows no signs of deterioration; on the contrary, in his efforts toward higher civic life, and toward the establishment of a permanent white middle class on the land, he shows that he is ever progressing to higher and higher levels.

Vaughan MacCaughey
College of Hawaii

SCIENTIFIC BOOKS

Stoichiometry. By Sydney Young, D.Sc., F.R.S. New York, Longmans, Green & Co. 1918. Pp. xii + 363. With 93 figures in the text. Second Edition. Price $3.75 net.

It is unfortunate, indeed, that general texts are not more often written by those who have done much research in the particular lines covered by the book—for the advantages of such authorship are plainly apparent in "Stoichiometry." Certainly no name of recent time has become more intimately associated with the *precise* determination of the physical constants of the gaseous and liquid states of aggregation than that of Young; and assuredly no one can speak with more authority than he of a subject which includes them; or treat with a clearer vision the things dependent upon them.

In this edition, the new experimental work, done since the original appearance of the book, has been ably summarized and included. In other respects, all that was said in praise of the first edition may be repeated even more emphatically in the case of the second. The inclusion of complete lists or references is one thing which renders the work especially valuable to the reader, for it thus serves as a point of departure for one wishing to make a more exhaustive study of any one of its component portions.

Like the same author's "Fractional Distillation," this is distinctly one of those books which should have a prominent place in every chemist's *working* library.

J. Livingston R. Morgan
Columbia University

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The eighth number of Volume 4 of the *Proceedings of the National Academy of Sciences* contains the following articles:

Hereditary Tendency to Form Nerve Tumors: C. B. Davenport, Station for Experimental Evolution, Carnegie Institution of Washington. The disease is not communicable. It affects blood relatives, both sexes nearly equally, and occurs without a break in the generations, about 50 per cent. of the individuals being affected. Apparently, therefore, the heredity factor in neurofibromatosis is dominant.

Arithmetical Theory of Certain Hurwitzian Continued Fractions: D. N. Lehmer, Department of Mathematics, University of California. Investigations on the successive values of the numerators and denominators of convergents.

On Closed Curves Described by a Spherical Pendulum: Arnold Emch, Department of Mathematics, University of Illinois. Some geometric properties of these curves are developed.

The Taxonomic Position of the Genus Actinomyces: Charles Drechsler, Cryptogamic

Laboratories, Harvard University. A morphological study for the purpose of determining the merits of various contending views.

Studies of Magnitudes in Star Clusters, VIII. A Summary of Results Bearing on the Structure of the Sidereal Universe: Harlow Shapley, Mount Wilson Solar Observatory, Carnegie Institution of Washington. A summary of results leads to a simple interpretation of star-streaming. The stars of Stream I. belong to the large moving cluster surrounding the sun, those of Stream II. belong to the galactic field.

Glacial Depression and Post-Glacial Uplift of Northeastern America: H. L. Fairchild, Department of Geology, University of Rochester. An illustration of the geophysical theory of isostacy.

A Bacteriological Study of the Soil of Loggerhead Key, Tortugas, Florida: C. B. Lipman and D. D. Waynick, College of Agriculture, University of California. A discussion of bacterial counts, nitrogen transforming powers of the soils, and nitrogen fixing powers and organisms.

Autonomous Responses of the Labial Palps of Anodonta: P. H. Cobb, Zoological Laboratory, Harvard University. The palp contains within itself the neuro-muscular organism necessary for the responses described, and therefore possesses an autonomy more complete than that of the vertebrate heart.

The Depth of the Effective Plane in X-Ray Crystal Penetration: F. C. Blake, Department of Physics, Ohio State University. In determining the value of h by means of X-rays, the "depth of the effective plane" was 0.203 mm. for calcite with a certain X-ray wave length. An attempt is here made to explain this theoretically.

The Myodome and Trigemino-Facialis Chamber of Fishes and the Corresponding Cavities in Higher Vertebrates: Edward Phelps Allis, Jr., Palais Carnolés, Menton, France.

The Effect of Inbreeding and Crossbreeding upon Development: D. F. Jones, Connecticut Agricultural Experiment station, New Haven. A continuation of work by East and Hayes on the naturally cross-pollinated corn plant, *Zea mays* L.

National Research Council: Executive Order Issued by the President of the United States May 11, 1918; Minutes of the Second Meeting of the Executive Board of the War Organization in Joint Session with the Council of the National Academy of Sciences; Minutes of Third Meeting of Executive Board of War Organization.

Report of the Annual Meeting of the Academy: Award of Medals; Research Grants from Trust Funds of the Academy.

THE ninth number of Volume 4 contains the following articles: *Metalliferous Laterite in New Caledonia:* W. M. Davis, Department of Geology and Geography, Harvard University. Laterite ores of the serpentine highlands seem to be local as to area of development and intermittent as to time or origin and duration of occurrence.

A Comparison of Growth Changes in the Nervous System of the Rat with Corresponding Changes in the Nervous System of Man: Henry H. Donaldson, Wistar Institute of Anatomy and Biology, Philadelphia. The five events in the growth of the nervous system of the rat, namely, (1) increase in total weight, (2) decrease in percentage of water, (3) accumulation of myelin, (4) maturing of the cerebellum, (5) attainment of mature thickness of the cerebral cortex, all take place at ages equivalent, or nearly equivalent to those at which they occur in man; and hence, by the use of equivalent ages there is a satisfactory method for making a cross reference between the rat and man.

Variation and Heredity During the Vegetative Reproduction of Arcella Dentata: R. W. Hegner, Zoological Laboratory, Johns Hopkins University. Within a large family of *Arcella dentata* produced by vegetative reproduction from a single specimen, there are many heritably diverse branches. These diversities are due both to very slight variations and to sudden large variations or mutations. The formation of such hereditarily diverse branches seems to be a true case of evolution

observed in the laboratory, and occurring in a similar way in nature.

The Importance of Nivation as an Erosive Factor, and of Soil Flow as a Transporting Agency, in Northern Greenland: W. Elmer Ekblaw, Crocker Land Expedition, American Museum of Natural History, and University of Illinois. Nivation and solifluction, characteristic processes of disintegration and denudation under subarctic or arctic conditions, appear to be of prime importance in the reduction of high relief of northern Greenland.

On the α-Holomorphisms of a Group: G. A. Miller, Department of Mathematics, University of Illinois. A solution of the problem: For what values of α is it possible to construct non-abelian groups which admit separately an α-holomorphism?

The tenth number of Volume 4 contains the following articles:

Measuring the Mental Strength of an Army: Major Robert M. Yerkes, Sanitary Corps, N. A. A review of the psychological undertakings in connection with the examination of the recruits for the U. S. Army.

Thermo-Electric Action with Thermal Effusion in Metals: A Correction: Edwin H. Hall, Jefferson Physical Laboratory, Harvard University. Supplementary to an earlier paper.

Invariants and Canonical Forms: E. J. Wilczynski, Department of Mathematics, University of Chicago. A general proof in the sense of Moore's general analysis of the fact that the coefficients of a unique canonical form are invariants.

Types of Phosphorescence: Edward L. Nichols and H. L. Howes, Department of Physics, Cornell University. Two types of phosphorescence known as *persistent,* and as *vanishing,* are distinguished and discussed. The types are apparently independent, and both may occur with a single source of excitation, and in a single substance.

The Smithsonian "Solar Constant" Expedition to Calama, Chile: C. G. Abbot, Smithsonian Astrophysical Observatory. A preliminary report on the aim and equipment of the Calama Expedition.

Maroon—A Recurrent Mutation in Drosophila: Calvin B. Bridges, Marine Biological Laboratory, Woods Hole.

Edwin Bidwell Wilson
Massachusetts Institute of Technology,
Cambridge, Mass.

SPECIAL ARTICLES

ON THE NATURE OF THE PIGMENTATION CHANGES FOLLOWING HYPOPHYSECTOMY IN THE FROG LARVA

It has been shown by Smith[1] and by Allen[2] that the removal of the hypophysis fundament from the young larval frog is followed by a marked change in pigmentation. Within seven to ten days after the operation—which is most successfully performed when the larva is 3.5–4.0 mm. in length—the color of the tadpole changes from black to "silvery," or as Smith describes it, the larva becomes an albino.

Smith and Allen hold quite different views as to the nature of this pigmentation change. Smith thinks that the silvery appearance of the operated tadpoles is due to a reduction in the number of melanophores in the epidermis and to a loss of the individual pigment granules contained in these melanophores. He states that the melanophores are equally expanded in the albinos and in the controls, "consequently the lighter color of the albinos can not be due to the contracted condition of the chromatophores but must be referred, in part, to the reduced number of melanin granules in the pigment cells of the epidermis."

Allen, on the other hand, believes that the lighter color of the operated larvæ is due to the fact that the epidermal pigment cells have migrated to deeper positions and that the pigment cells are contracted throughout all parts of the body. He is convinced that "there is no disappearance and bleaching of pigment granules as asserted by Smith." Each of these observers, apparently, has based his conclusions upon the study of sections entirely. It will be recognized readily that in

1 Smith, P. E., *Anatomical Record,* Vol. 11, p. 57, 1916.

2 Allen, B. M., *Biological Bulletin,* Vol. 32, p. 117, 1917.

the study of such large cells as the amphibian chromatophores a much more satisfactory microscopic preparation may be obtained by mounting pieces of skin entire.

During the course of experimental studies on the relation of certain of the endocrine glands to pigmentation and growth changes in the frog, striking objective proof has been obtained that the "silvering" which follows hypophysectomy is due mainly to contraction of certain melanophores and not to any marked reduction in the amount of pigment material present.

The experiments to be described were performed upon larvæ of *Rana sylvatica.* This frog is very darkly pigmented in young stages and the "silvering" which follows hypophysectomy is consequently a very striking color change. The hypophysis was removed, following the methods of Allen and of Smith, at a stage just preceding the appearance of muscular activity. The operated larvæ were immediately returned to large crystallizing dishes containing city water (Ann Arbor, Mich.). Although this water is very hard and may contain traces of chlorine, there was not the high mortality among operated tadpoles which Allen noted. The characteristic silvering appeared from the eighth to the tenth day following the operation. As noted by the previous observers mentioned the operated larvæ were constantly smaller than controls of the same age and were somewhat more active.

When a length of from 12 to 14 mm. had been attained groups of the silvery larvæ were placed in a dilute extract of pars intermedia of beef pituitary or in an emulsion made by shaking a few mgm. of dried pars intermedia in 100 c.c. of distilled water. For each experiment a control group of larvæ was placed in an equal amount of distilled water. The larvæ placed in contact with the pars intermedia substance soon underwent a striking change from silvery to dark, in which condition they closely resembled the normal tadpole. This change began to be apparent in 15–30 minutes and attained a maximum in from one to three hours, depending on the strength of the extract or emulsion employed. When returned to fresh water the darkened larvæ soon regained their silvery appearance (one to three hours).

This experiment proves conclusively that the silvery appearance of the hypophysectomized larvæ is not due primarily to a loss of pigment substance. It indicates rather that it is due to a sustained contraction of pigment-bearing cells, which may be caused to expand again by suitable stimuli.

To test the validity of the latter assumption the experiment was repeated with the larvæ held in Clarke's observation chamber so that changes in the pigment cells could be watched under the microscope. In silvery larvæ the sub-epidermal melanophores were found to be contracted into dense spherical masses, whereas in normal larvæ the same cells were greatly expanded so that processes of neighboring cells were almost in contact. When a silvery larva was subjected to the action of an extract of pars intermedia the contracted pigment cells were seen to expand slowly. In one experiment a definite change in the cell under observation could be noted within eighteen minutes. The cell continued to expand slowly by sending out pseudopodia-like processes into which pigment granules could be seen to stream.

To further elucidate the nature of the pigment change *toto* mounts of pieces of skin stripped from normal and experimental larvæ after fixation in Bouin's fluid, were prepared. as follows: (*a*) normal, (*b*) silvery (hypophysectomized), (*c*) darkened silvery (hypophysectomized, under influence of pars intermedia extract).

In addition to the sub-epidermal melanophore with branches so numerous that a typical "mossy" appearance is presented, the skin of the normal frog larva contains another type of pigment cell, with relatively few branches, situated in the epidermis. The latter cells are said not to be contractile (Hooker[3]).

Skin mounts prepared from silvery larvæ show that the sub-epidermal pigment cells are

[3] Hooker, D., SCIENCE, N. S., Vol. 39, p. 473, 1914.

contracted, some completely so that they form dense spherical masses; others are only partially contracted. This is in accord with what may be observed in the tail of the living silvery tadpole. Another feature which immediately attracts attention is the apparent absence of the epidermal melanophores. Upon closer examination the faint outlines of a few such cells may be made out. The cells contain very few pigment granules. Whether the remaining cells have migrated from the epidermis to deeper parts, as stated by Allen, or whether they have become invisible from loss of pigment granules could not be determined. It is apparent, however, that those occasional epidermal melanophores which may be identified contain only a small proportion of the number of pigment granules to be found in the normal condition. Whether the pigment granules have been changed and absorbed or have left the melanophore to become more widely distributed likewise has not as yet been established.

When a silvery larva has been darkened by the action of an extract of pars intermedia the sub-epidermal melanophores are found to be expanded, thus approximating the normal condition. The epidermal pigment cells, however, are not restored.

It may be concluded, then, that the change in color which follows hypophysectomy in the frog larva is due primarily to a contraction of the sub-epidermal melanophores. Only secondarily is it due to a loss of pigment granules from certain of the epidermal melanophores, and to a possible migration or loss of other epidermal melanophores.

Wayne J. Atwell

Department of Anatomy,
University of Buffalo

THE PALEONTOLOGICAL SOCIETY

The Paleontological Society held its tenth annual meeting at Baltimore, December 28, 1918, meeting in affiliation with the Geological Society of America. The meeting was held in the civil engineering building of Johns Hopkins University, with an attendance of about forty members and visitors. Following the business session and the presentation of appreciations of the life and work of four deceased members, the reading of papers bearing upon the various branches of paleontology and stratigraphy was commenced and continued until late in the afternoon. In the evening the members attended the annual dinner with the Geological Society of America at the Southern Hotel.

Of special mention among the papers presented, listed below, was the address of the retiring president, Dr. F. H. Knowlton, on "The evolution of geologic climates," in which the evidence of paleobotany was the predominant theme, and the papers on the Philosophical Aspect of Paleontology and the Economic Value of the Science. Important stratigraphic and paleontologic results were announced by the members particularly regarding the Coal Measures of Maryland, the Oxfordian of Cuba and the Tertiary rocks of South America.

The following papers were read:

Paleontologic Papers

Relation of the Holochoanites and the Orthochoanites to the Protochoanites, and the significance of the Bactritidæ: Amadeus W. Grabau.

On the inclusion of the Pleistocenic period in the Psychozoic Era: Amadeus W. Grabau.

The philosophical aspects of paleontology: John M. Clarke.

Characters and restoration of Cope's Sauropoda: Henry Fairfield Osborn.

Camarasaurus and Amphicœlias from Canyon City: Henry Fairfield Osborn and Charles C. Mook.

Orthogenetic development of the costæ in the Perisphinctinæ: Marjorie O'Connell.

Discovery of the Oxfordian in western Cuba: Barnum Brown and Marjorie O'Connell.

A new Eurypterid horizon: George H. Chadwick.

The economic value of paleontology: Ralph Arnold.

Stromatopora growth on edgeon conglomerates from the Silurian: John M. Clarke.

Stratigraphic Papers

The age of certain plant bearing beds and associated marine formations in South America: Edward W. Berry.

The stratigraphy and correlation of the coal measures of Maryland: Charles K. Swartz, W. A. Price, Jr., and Harvey Bassler.

The typical section of the Allegheny formation: Charles K. Swartz and Harvey Bassler.

The Eocene divisions of California: Bruce L. Clark.

Some problems of the Adirondack Precambrian: Harold L. Alling.

Permo-Triassic of northwestern Arizona: Harvey W. Shimer.

The stratigraphy and structure of the Newark system in Maryland and its relation to the Newark system of eastern North America: George Edwin Dorsey.

Remarkable persistence of thin horizons: GEORGE H. CHADWICK.

Portage stratigraphy in western New York: GEORGE H. CHADWICK.

The result of the ballots for officers for 1919 was as follows:

President—Robert T. Jackson, Peterborough, N. H.

First Vice-president—Gilbert Van Ingen, Princeton, N. J.

Second Vice-president—Walter Granger, New York City.

Third Vice-president—T. Wayland Vaughan, Washington, D. C.

Secretary—R. S. Bassler, Washington, D C..

Treasurer—Richard S. Lull, New Haven, Conn.

Editor—W. D. Matthew, New York City.

R. S. BASSLER,
Secretary

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

THE American Psychological Association held its twenty-seventh annual meeting at Johns Hopkins University on December 27 and 28. Considering the fact that many of the members made other plans when it was announced in November that there would be no meeting, the sessions were very well attended, there being about seventy members present. Owing to illness the president, Professor J. W. Baird, of Clark University, was not able to preside nor to give his presidential address.

The papers consisted with one exception of descriptions of the war activities of the members. The program was as follows: Research in psycho-pharmacology, Dr. David I. Macht; Study of ocular functions with special reference to aviation, Professor C. E. Ferree; Revision of the definition for "moron"; Captain R. L. Sylvester; Psychology of morale, Major Wm. S. Foster; Selection and training of telegraphers, Professor L. L. Thurston; Some problems of reeducation, Professor S. I. Franz; Principles underlying the classification of men in the Students' Army Training Corps, Professor T. L. Kelley; Examination of the emotional fitness for warfare, Professor R. S. Woodworth; Practical application of army trade tests, Major J. W. Hayes; Army personnel work: implications for education and industry, Lieutenant Colonel W. V. Bingham; The work of the psychological committee of the National Research Council and of the Division of Psychology, Major R. M. Yerkes; Methods of mental testing used in the United States Army, Major Lewis M. Terman; Psychological service in army camps, Major George F. Arps; Results and values of psychological examining in the United States Army, Dr. Mabel R. Fernald; The relation of intelligence to occupation as indicated by army data, Dr. J. W. Bridges; Some possible effects of the war on American psychology, President G. Stanley Hall; Functions of psychology in rehabilitation of disabled soldiers, Major Bird T. Baldwin; A program for mental engineering, Lieutenant Commander Dodge; Official method of appointing and promoting officers in the Army, Colonel Walter Dill Scott; Psychological investigations in aviation, Major Knight Dunlap; Speech reconstruction in soldiers, Professor W. B. Swift.

Saturday afternoon there was a symposium upon "The future of pure and applied psychology." Professor Thorndike expressed the opinion that in twenty years there would be as many "doing" as teaching psychology, but that both groups must be thoroughly scientific. He saw no reason why the Ph.D. degree in psychology should not represent both types. President Hall stated that psychology should be kept pure, but not so pure that it could not be helpful. Its motto should be "service" in the best sense of the term. Major Yerkes discussed the future relation of psychology to a permanent National Research Council.

Professor E. L. Thorndike, as the retiring vice-president of Section H of the American Association for the Advancement of Science, delivered an address upon "Scientific personnel work in the army" and Professor E. F. Buchner as retiring vice-president of Section L of the American Association for the Advancement of Science spoke upon "Scientific contributions of the educational survey."

A brief report of the contents of all the papers will be made in the February number of *The Psychological Bulletin.*

Colonel Walter Dill Scott was elected president of the association for 1919 and Major Bird T. Baldwin and Major Lewis M. Terman members of the Council.

Herbert Sidney Langfeld
Secretary

THE OPTICAL SOCIETY OF AMERICA

The third annual meeting of the Optical Society of America was held under the auspices of the American Association for the Advancement of Science in Baltimore, December 27. The program consisted of the scientific papers listed below with a Symposium on The Future of Applied Optics and a business meeting.

MORNING SESSION, 9:30

The colorimetry of white surfaces: A. P. Pfund.

The measurement of reflection and transmission factors: M. Luckiesh.

The design of lenses for aerial photography and tests of calcium as a desiccator in optical instruments: C. W. Frederick.

Retinal fatigue for luminosity with spectral stimuli: L. T. Troland.

A new yellow dye and light filters made from it: C. E. K. Mees and H. T. Clarke.

The contraction of photographic images: F. E. Ross.

Refinements in spherometry: G. W. Moffitt.

The problem of magnification in fire control instruments, and The transmission of certain glasses in the absorbent region: E. D. Tillyer.

A possible new lens material: P. G. Nutting.

A chart method of testing photographic lenses: L. E. Jewell.

Monocular vs. binocular field glasses: E. P. Hyde and Committee.

A testing apparatus for stereoscopic vision: H. Kellner.

A one-term pure exponential formula for the spectral distribution of radiant energy from a complete radiator: I. G. Priest.

Photoelectric spectrophotometry by the Null method: K. S. Gibson.

The protection of silvered surfaces: F. L. G. Kollmorgen.

The proper type of absorption glass for an optical pyrometer: P. D. Foote.

Some characteristics of glasses in the annealing range: A. Q. Tool and J. Valasek.

Expansion coefficients of optical glasses: C. G. Peters.

AFTERNOON SESSION, 2 P.M.

Symposium on Applied Optics, with Special Reference to the Future of the Optical Industry in this Country.

I. *The optical industry in war time:* Dr. F. E. Wright.

II. *The readjustments of the industry to peacetime demands for, and the future of manufacturing in:*

1. *Optical glasses:* Dr. G. W. Morey.
2. *Photographic lenses and cameras:* Mr. C. W. Frederick.
3. *Projection apparatus:* Dr. H. P. Gage.
4. *Microscopes, field glasses and telescopes:* Dr. H. Kellner.
5. *Photographic goods:* Dr. C. E. K. Mees.
6. *Special research apparatus:* Mr. P. V. Wells.
7. *Spectacle lenses and optometry:* Mr. E. D. Tillyer.
8. *Illuminating engineering:* Dr. E. P. Hyde.

III. *The future of applied optics and the future needs for:*

1. *Education and training:* Dr. Mees and Professor Southall.
2. *Scientific control in manufacturing:* Dr. Kellner and Mr. Keuffel.
3. *Testing and research:* Dr. Nutting.

EVENING SESSION, 7:30 P.M.

Business meeting.

The meeting was an enthusiastic one attended by about 80 persons. Resolutions were passed and committees appointed looking toward the closer cooperation between designers, manufacturers and users of optical goods of all kinds in America.

The officers of the society for 1919 are:

President—Dr. F. E. Wright, Geophysical Laboratory, Washington.

Vice-president—Professor F. K. Richtymer, professor of physics, Cornell.

Secretary—Dr. P. G. Nutting, Westinghouse Research Laboratories.

Treasurer—Mr. Adolph Lomb, Bausch & Lomb Optical Company.

Members at Large of the Council—Professor J. P. C. Southall, Columbia University; Dr. L. T. Troland, Harvard University; Dr. W. B. Lancaster, Boston; Dr. H. E. Ives, Washington.

The next general meeting of the society will be held in connection with American Association for the Advancement of Science next December.

P. G. Nutting,
Secretary

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SCIENTIFIC PERSONNEL WORK IN THE ARMY[1]

The sciences dealing with human nature were brought to bear upon the problems forced upon America by the world war. Anthropology and psychology, economics and statistics, history, sociology and education, were put in service to improve our use of man-power, just as the physical and biological sciences were put in service to increase, economize and mobilize the nation's physical resources.

Consider a few illustrations. At one of the cantonments, within a few months' time, over 30,000 men were given a uniform standard intelligence-test and, as a dircet result of it, 600 men who would have been a detriment and even a positive danger to their fellow soldiers were sent away before time and money were wasted on their military education.

Certain very important institutions were receiving candidates a large percentage of whom were discarded, with little but discouragement and envy to show in return for the expense of their time and the government's money. Yet these candidates were chosen by a system which already represented the acme of common sense administered by extremely able men. A scientific study of some five hundred cases showed where much of the trouble lay and provided a remedy.

Under the pressure of the war the regular army scheme for measuring the qualifications and efficiency of its officers could not be operated. Nor would it have been suitable for the two hundred thousand officers taken from civil life with only a few months of military training. A workable record and rating plan was prepared by an expert in applied psychol-

[1] Address of the vice-president and chairman of Section H, Anthropology and Psychology, Baltimore, December, 1918.

ogy, tested carefully in certain camps, and put into force throughout the army.

At one of the largest naval radio schools the candidates were admitted in part through a series of tests devised for the purpose by one man of science, and their instruction was directed by methods devised by another.

In one of the large munition factories, a number of psychologists were kept constantly at work studying the means of selecting the right individuals as employees and finding the optimum conditions for their work.

Multiply such cases as these many many times; add to them the scientific personnel work done by physiologists and medical men; add further that done by the many modern business men whose work is so based on principles and verified by experiment that we should gladly claim them as fellow scientists—and the total would probably be the greatest increase in scientific control over the management of men ever made in any year in any country.

Until the war-history of the scientific activities of the National Research Council, the various emergency boards and bureaus, and the military organizations themselves is written, nobody will be able to describe or assess this work as a whole or the particular share of it due to applied psychology. I regret also that circumstances have prevented me from speaking, as I had hoped to do, from even a partial study of the records and reports available in manuscript in Washington and elsewhere. I can speak only in a very informal way in reminiscence of the activities seen, or shared, during these eighteen months.

Scientific personnel work has followed two main lines which we may call *mass* work and *analytic* work. These of course shade into each other and almost always cooperate, but the distinction will be helpful, at least for presentation.

MASS WORK

As a result of the prompt, energetic and patient labors of Yerkes and his associates of the psychology committee of the National Research Council, and of the subcommittee of the American Psychological Association, about seventeen hundred thousand soldiers were given a standard examination for intelligence, so devised that a small organization of examiners and clerical helpers could test and report on five hundred or more individuals a day. Within a day or two after a train-load of recruits reached a camp, it was possible for the camp psychologist to give substantial aid in such matters as:

1. The discovery of men whose superior intelligence suggests their consideration for advancement, for example, to posts as non-commissioned officers.

2. The discovery of men whose low grade of intelligence renders them either a burden or a menace to the service.

3. The selection and assignment to Development Battalions of men who are so inferior mentally, that they are suited only for special work.

4. The prevention of undesirable differences of mental strength between different regiments or companies.

5. The early recognition of the mentally slow as contrasted with the stubborn or disobedient.[2]

The history of this work in its early stages has been related by Yerkes, and its later development will doubtless be made public. Amongst the many important contributions to knowledge of the significance of such a test, I quote one from the preliminary report recently issued.

The median scores for recruits from different civil occupations are in summarized form as follows:

45 to 49	50 to 54
Farmer	Stationary gas-engine man
Laborer	Horse hostler
General miner	Horse shoer
Teamster	Tailor
	General boiler maker
	Barber

55 to 59	60 to 64
General carpenter	General machinist
Painter	Lathe hand
Heavy truck chauffeur	General blacksmith
Horse trainer	Brakeman
Baker	Locomotive fireman
Cook	Auto chauffeur
Concrete or cement worker	Telegraph and telephone lineman
Mine drill runner	Butcher

2 From "Army Mental Tests."

Bricklayer
Cobbler
Caterer

Bridge carpenter
Railroad conductor
Railroad shop mechanic
Locomotive engineer

65 to 69
Laundryman
Plumber
Auto repairman
General pipe-fitter
Auto engine mechanic
Auto assembler
General mechanic
Tool and gauge maker
Stock checker
Detective and policeman
Tool-room expert
Ship carpenter
Gunsmith
Marine engine man
Hand riveter
Telephone operator

70 to 74
Truckmaster
Farrier and veterinarian

75 to 79
Receiving clerk
Shipping clerk
Stock keeper

80 to 84
General electrician
Telegrapher
Band musician
Concrete construction foreman

85 to 89
Photographer

90 to 94
Railroad clerk

95 to 99
General clerk
Filing clerk

100 to 104
Bookkeeper

105 to 109
Mechanical engineer

110 to 119
Mechanical draughtsman

115 to 119
Stenographer
Typist
Accountant
Civil engineer

120 to 125
Y. M. C. A. secretaries
Medical officers

125 and over
Army chaplains
Engineer officers

This table shows conclusively that in the sort of ability measured by the test (1) skilled mechanics and tradesmen, men who work with tools, are in general very closely alike and very low—near the level of the unskilled laborer; (2) clerical workers are in general very high—near the level of professional men. Either the clerical worker is a man of much greater general intelligence than the blacksmith, carpenter, locomotive engineer, machinist, tool maker, gunsmith or assembler; or the ability measured by the test is very much specialized; or both of these statements are true in a more moderate form. The matter is one of great importance. In proportion as it is true that the more intelligent men seek clerical work rather than work in skilled trades, an essentially invidious class distinction will tend to have a real basis in fact; and the management of business concerns will tend to fall into the hands of men trained in the office and salesroom rather than in the shop. In proportion as this representative of our standard tests of intelligence is specialized, overweighting ability to think with words and symbols in comparison with ability to think with materials and mechanisms, our whole procedure in measuring intelligence requires a critical review; and probably the common view of intelligence requires reconstruction.

No less significant is the variability within each occupational group. Taking the measurements as they stand, the 75 percentile unskilled laborer is up to the level of the median general mechanic, tool-room expert, or automobile mechanic, and up to the level of the 25 percentile mechanical engineer. The 75 percentile railroad clerk is at the level of the average accountant or civil engineer. The 75 percentile receiving or shipping cleark is at the level of the 25 percentile physician. This variability would be reduced by longer and repeated tests, but, unless the test as given has a very large probable error, it would still be enormous. It would still imply that there were in the occupations supposed to demand a high minimum standard of intelligence, a very large number of dull men; and in the occupations supposed to give little opportunity for the use of intellect, a very large number of gifted men and consequently a large unused surplus of intellect. Further information concerning the exact nature of the abilities of which the test is symptomatic is evidently important here.

As one considers the use of intelligence tests in the army, the question at once arises, "If for the sake of war we can measure roughly the intelligence of a third of a million soldiers a month, and find it profitable to do so, can we not each year measure the intelligence of every child coming ten years of age, and will not that be still more profitable?" A more extended test such as will place an individual on the scale for intellect for his age with an average error of not over 0.2 the mean square deviation for his age, would

doubtless be desirable. A more varied test which will prophesy ability to work with things and human beings as well as ideas and symbols would doubtless be desirable. Series of tests that could be made public without serious injury from deliberate preparation by tutors would also be desirable, and probably necessary. However, even with these more rigorous requirements, the expense for an annual nation-wide inventory of the intelligence of the ten-year-old cross section would not equal the cost of the war to America alone for five hours.

The results of such a census of intellect, especially if repeated at 14, 18, 22, would give superintendents of schools, commissioners of charity, mayors of cities and governors of states facts which they really need every day in their business.

A second main line of scientific work for large groups of soldiers was carried on by the Committee on Classification of Personnel in the Army under the leadership of Walter Dill Scott.

As a result of work done by him for the army in the first months of the war there was constituted in August of 1917 a Civilian Committee[3] of seven psychologists and three experts in the selection of men for employment. This committee worked first under the jurisdiction of the Adjutant General and later under the General Staff. This committee urged, and was soon entrusted with, the work of planning and carrying out an inventory of the man power of the National Army and establishing Personnel units in each of the sixteen cantonments. By these means each man's special abilities could be considered so that the right man would be put in the right place. These personnel units were found to be of direct practical service, were soon established in the National Guard as well as in the National Army, and were later extended to the Staff Corps and to the Students' Army Training Corps. Schools were established to train officers in the committee's system of interviewing recruits, recording their abilities and training, and using these facts in placing and transferring men.

[3] Just before the close of the war, the members of the committee and the group of associates whom they had organized were being commissioned.

A modern army is specialized into over two hundred occupations each as essential in its way to success in war as is the combat work of infantrymen, machine gunners or signallers. An army fights with a force of specialists ranging from artists to automatic-screw operator, bacteriologist to butcher, cargador to cupola tender, detective to dog trainer. The Committee on Classification of Personnel had to fill such orders for man power as:

One hundred and five artists, scene painters, architects, etc., for camouflage work for the Engineer Corps.

Three thousand typists, needed at once.

Forty-five enlisted men capable of leadership who are competent in the distribution and handling of oils and gasolines, fit to receive commissions in the Quartermaster Corps.

Professors of mathematics equipped to teach in the Field Artillery schools.

Meteorologists and physicists able to learn quickly to make meteorological observations and predictions.

Six hundred chauffeurs who speak French.

Electric crane operators.

In August, 1918, nearly four hundred such requisitions calling for over two hundred thousand men were filled. They had to be filled promptly in almost every case, and each had to be filled so as to leave the best possible material to fill every other requisition.

From one point of view this work was simply that of an enormous and glorified employment agency; and the scientists and business men engaged in it would be content if they had done nothing more than conduct an efficient agency for supplying to the army the skill it needed, when and where it needed it. From another point of view the work was a continuous study of human nature and application of scientific management.

In connection with the inventory of each man's abilities, tests to measure proficiency in each of about a hundred trades were devised, in the eight months from March, 1918. By the end of October these tests were in regular

operation in twenty-one cantonments, and about 125,000 men had been tested. Their operation made it sure that a man said to be a journeyman ship-carpenter really could do the work of a journeyman ship-carpenter if he was to be sent to the Emergency Fleet Corporation as such; that a man said to be a skilled truck-driver really could drive a truck as required in war-work, if he was to be sent to France for that work; that in general each man's statements and reported career were checked by objective test and measurement.

These trade tests were devised to fit the needs of the army in the war emergency and did so. They would need modification and extension to meet the needs of employers, labor unions, civil-service examining boards and the like. But the principles and methods according to which they were made have been fully justified. To the question "How well does individual A know trade I?" we can obtain a definite quantitative answer and can reduce its probable error to harmless dimensions. Just as we framed standard, workable, convenient, inexpensive, objective instruments to make sure that men assigned to certain work in the army could do that work satisfactorily, so we could upon order frame instruments which labor unions or civil service boards could use as admission examinations, which economists or business men could use in investigations of wages and production, or which a local survey could use in an intimate study of the total life of a community.

With respect to this inventory of man-power and organized effort to put the right man in the right place, it is probably no exaggeration to say that every thoughtful person who became well acquainted with its operation wished that it might be to some extent continued in peace time. "Why," we have been asked, "could not a progressive state inventory all its man power and plan for using it wisely for the purposes of peace?"

The special difficulties caused by geographical distribution and migration could probably be overcome, at least in certain of our states. The cooperation necessary from all citizens might be obtained. A system adequate for recording in usable form the essential facts for a state's entire population might be less expensive and quicker in action than would have been expected to be the case before the army methods were worked out.

An even greater difficulty lies in the fact that we lack laws, customs and experience concerning the use of such information; and it is hard to see just how efficient use of it to answer reasonable queries by federal and state bureaus, chambers of commerce, labor unions, boards of education and other reputable organizations could be encouraged and improper uses by futile or even disreputable concerns could be avoided. If a state could be sure that the information would be used by the right persons in the right way, it might therefore reasonably consider trying to make and maintain such an individualized inventory of its man power.

ANALYTIC WORK

What is called, for lack of a better term, analytical personnel work, is more or less clearly distinguished from the mass work so far described in several ways. It affects fewer individuals; it affects them in more specialized ways; it depends more upon insight and experiment to learn what to do and less upon executive energy and organization for doing it. To such work many men have contributed, and I can only illustrate it.

Early in the war, the problem of selecting from a given number of men those best fitted for rapid training as gun pointers on shipboard was referred to the Subcommittee on the Psychology of Special Abilities, and at their request referred to Dr. Raymond Dodge. He studied the task of the gun-trainer and pointer, the situations and responses involved, the methods of testing their ability then in use, the men from whom selections would be made, and the practical conditions which any system of selection for this work must meet. He had the problem of imitating the apparent movements of the target which are caused by the rolling and pitching of the gun-platform as a distant object would appear to a gun-pointer on a destroyer, a battleship or an armed mer-

chantman. He solved this by moving the imitation target through an 84-phase series of combined sine curves at variable speeds by a simple set of eccentrics, motor-run. He had the problem of imitating the essentials of the control of the gun by the gun-pointer and of recording in a fuller and more convenient form the exact nature of the gunner's reactions in picking up the target, in getting on the bullseye, in keeping on, in firing when he was on, and in following through. He solved these by a simple graphic record showing all these reactions on a single line that could be accurately measured, or roughly estimated.

Subsequently he made an apparatus that could be used not only to test a prospective gun-pointer's ability, but also to train both gun-trainers and firing gun-pointers four at a time. The demand for these instruments has been so great that sixty have been built by the Navy for use at shore training stations. The success of this led to further similar work, especially on the problem of the listener, the lookout and the fire control party.

The selection of military aviators is interesting as showing the complexity of a single concrete personnel problem. To be a successful military aviator in the United States Army under the conditions of the great war required first, that the individual be able to complete a theoretical and practical course on the ground (in a School of Military Aeronautics); second, that he be able to learn to fly satisfactorily within a reasonable time in an Aviation School or "Flying School"; third, that he possess the mental and moral make-up qualifying him for a commission in the army; fourth, that he prove competent in actual military work "over the lines" as pursuit pilot, bombing pilot, or pilot carrying an observer, or as a pilot instructor.

If we had perfectly accurate measures of a hundred thousand men available for the four traits: (1) ability in the ground school; (2) ability in the primary training in the fundamentals of flying; (3) standing in the composite of manhood and devotion characteristic of the ideal commissioned officer; (4) fitness for the actual work of a military aviator at the front; we should still have a complex problem. For these four abilities are very imperfectly correlated. The correlation of (1) and (2) is apparently not over .3. The correlation of (1) and (3) is probably not over .5. That of (1) and (4) is almost certainly not over .4. That of (2) and (3) may be as low as .3. That of (2) and (4) and that of (3) and (4) are not known, but it is certain that neither is very near 1.00.

Consequently, even if perfect prophecies could be made in respect to a man's fitness for each of the four requirements, the use of them to give the maximum of satisfaction of (3) and (4) (general officer quality and actual success as a military aviator) with the minimum of waste of time and money in respect to (1) and (2) is a problem demanding careful analysis.

A far greater difficulty of course was to discover means of prophesying abilities in a school such as had never before existed, in an art which only a few score men in the country had learned, and in a form of warfare which was only three years old and was changing its nature radically every few months.

Progress was necessarily slow and piecemeal, and anything like a complete and precise bill of specifications of the successful military aviator in terms of traits observable in a young man at work and at play on the ground is still remote.

Some of the steps in the progress may serve to illustrate further the analytic side of personnel work. In a study of the qualities used by examining boards to select future aviators, it was apparent that amount of schooling was the closest symptom of success in the work of the ground school. An experimental investigation was then undertaken to decide whether the score in a systematic test of intelligence or mental alertness might not be a useful addition to the scores for amount of schooling. Such a test was devised which gave a better prophecy of success in the ground school than amount of schooling, the correlations being, respectively, about *.50* and *.25*. Application of the partial correlation technique showed that the test score was the primary factor, amount

of schooling having its significance in this case chiefly indirectly as evidence of the possession of the abilities measured by the test. The correlation of the test score, independent of schooling, with success in the ground school was about .4. The correlation of amount of schooling, independent of the test, with success in the ground school, was less than .2. Amount of schooling is thus shown to be useful rather as a rough symptom of breeding, social status and viewpoint than as an index of intellect. That is better measured by a systematic test.

It could be affirmed a priori that the score in the test of mental alertness would not select against success in ability at flying itself, general fitness to be an officer, or success in actual warfare over the lines. But it might be that, if very accurately prophetic symptoms of these were at hand, they should be used pure, undiluted by mental alertness.

Consequently the significance of the test score for these was determined and compared with other symptoms. To make a short story out of a long and laborious inquiry, it was found that the test score correlated positively (about .3) with ability to learn to fly, and also with general officer-quality. Had the war lasted its correlation with success at the front would have been determined. It was also shown that dilution of a more valuable symptom by the test score was in all probability impossible, since the test score retained a positive partial correlation, independent of such more valuable symptom. Thus, although what we may call athletic mechanical ability (as in sailing a boat, riding a horse or motor-cycle, or shooting) sems to correlate much more closely with ability to fly well, than does the test score, a properly weighted composite of the two correlates still more closely. The same will hold of a composite with courage, or with nervous stability. So the test score may be used as an aid in selection for fitness for one of the four requirements, without fear of selecting the less fit for any other one of the four.

Almost as soon as the training of reserve military aviators began, in June and July, 1917, Burtt, Troland and Miles at Cambridge, and Stratton at San Diego, began a tryout of tests such as their consideration of the reactions involved led them to think might be prophetic of success in learning to fly. Later the writer investigated the physical, personal, educational and athletic records of men reported as superior and inferior by the flying schools as far as such reports were obtainable. Cooperation of the Committee on Classification of Personnel in the Army with the Personnel and Training Sections of the Division of Military Aeronautics, secured the detail of Dr. Henmon and Dr. Stratton in April, 1918, to study this problem further with a hundred men who learned to fly easily, a hundred men who learned to fly slowly or poorly, or not at all, and a hundred men taken for a test prophecy. It had already become apparent that no one trait of body or mind was clearly and closely correlated with success in flying—that a large number of factors were involved, so that a series of tests each properly weighted, must be combined to give a prophecy close enough to be of practical value. This series was made available for forty-five of the "unknowns" and a prophecy submitted to the effect that five of these cadets would show as many discharges or transfers for inability to learn to fly as all the other forty. This prophecy was verified and provision was made by the army for continued research along these lines under Captain Stratton, and for four special examining units under the direction of Captain Henmon to apply the tests to candidates for cadetships on a flying status.

In the spring and summer of 1918 Eno, aided by Fry, had been working on an apparatus to mimic to some extent the reactions involved in pointing a plane quickly and accurately at a target and to record these reactions in a precise and usable form. Dunlap had developed a systematic test of the changes produced by oxygen-want in an individual's ability in a complex sensory-motor performance somewhat equal in difficulty to the work of a man in combat flying. This was adopted as a regular feature of the differential test of a flyer's ability to withstand oxygen-want in

high altitudes. Parsons was testing the significance of the duration of nystagmus after rotation for future success in flying in the case of naval aviators; and his negative results were corroborated by the writer, and supported by Dodge's analysis of the reaction themselves. Shepard had devised and was standardizing tests of observation of a modifiable landscape. Other work helped to differentiate the qualities of a successful flying officer from those of a successful officer in general.

The formal procedure which was to go into operation for the selection of some twelve hundred aviation cadets per month from the Students' Army Training Corps, beginning in November, 1918, was in fact based in large measure on work done by men of science and the Personnel and Training Sections of the Air Service. Working together they had replaced the practise of selecting for flyers on the basis of general officer quality, by a bill of specifications of the sort of man demonstrably fit to complete the course in the ground school, learn to fly in a reasonable time, and give promise of achievement as a flying officer at the front. At the same time means were provided to do this without diverting from any other staff corps or from the line, men who, though fit to be flyers, were still fitter for other service.

I ought, in justice to the analytic personnel work, to give a wider sampling of its results, but I can not resist the temptation to use the few minutes remaining for two general reflections concerning psychology in relation to personnel practise in general.

The applied psychology or human engineering which has been developing so rapidly in the last decade has learned, in the war, if not before, that nothing short of the best in either ideas or men can do its work. Applied psychology is much more than cleverness and common sense using the facts and principles found in the standard texts. It is scientific work, research on problems of human nature complicated by conditions of the shop or school or army, restricted by time and labor cost, and directed by imperative needs.

The secret of success in applied psychology or human engineering is to be rigorously scientific. On every occasion when the principles of sound procedure were relaxed because of some real or fancied necessity, the work suffered. The chief principles in much of this personnel work concerned obtaining data from the sources possessed of fullest and most intimate knowledge, working only with data of measured reliability, determining the significance of facts by their proved consequences and correlations, and verifying conclusions by a prophecy and experiment. Whenever we made the extra effort and sacrifice necessary to tap the best sources of information about a man, rather than the next to the best, there was a gain. When we took pains to compute the reliability coefficients of all our data before going further with them, we saved time in the long run. Every failure to check apparent meanings by objective correlations was disastrous. An unverified hypothesis may possibly be a relatively harmless luxury if all one does with it is to think; to act on it is a grave danger.

Making psychology for business or industry or the army is harder than making psychology for other psychologists, and intrinsically requires higher talents. The scientist doing work for the inspection of other men of science is in large measure free to choose his topics, and to follow up any one important outcome regardless of what task he originally set himself. The scientist who is assigned a problem and is without credit if, instead of its answer, he produces something eventually far more important, has to be more adaptable, more persistent and more ingenious, if he is to succeed equally often. It is relatively easy to be scientific when you can direct your talent in any one of ten thousand directions; yourself asking the questions for which you proceed to find answers! Psychology applied to the complicated problems of personnel work represents scientific research of the most subtle, involved, and laborious type.

I have by intention omitted the names of the psychologists who have shared in this work, save where identification seemed necessary.

The list would be far too long. At the close of the war over a hundred psychologists had received or were about to receive commissions in the army; many more were doing work equal in merit to that done by the men commissioned; many were fulfilling the regular duties of teaching and devoting to war work the time previously given to scholarship, research and personal affairs; many more were carrying the extra burdens of regular work due to the more direct national service of others. If there were any differences in sacrifice or in achievement, they may well be left hidden in the more important fact that the psychologists of America worked to help win the war and worked together.

E. L. THORNDIKE

PUMPELLY'S REMINISCENCES[1]

PHYSICISTS and farmers are agreed that after the cider has been squeezed out, what remains of two apples can be contained in less than the volume of one. So it is with these "Reminiscences": by squeezing out the rich juice of the narrative, as some impatient and matter-of-fact man of the street might advise, the remains of the two large volumes could be reduced to a single small one; but how disappointed that compressed record, with every story dried to mere pomace, would have left the lingering reader! The detailed narratives of deliberate pages like these are not only of deep interest to many sympathetic contemporaries of the author, but of immense value to their studious successors; for the well-filled books reveal the deeper meaning that lies behind a mere chronicle of events and dates. Would that more of our eminent men might employ the leisure of their later years—if perchance their later years are spent in leisure—in writing out their memories, for the enjoyment of their younger friends and the edification of posterity. Yet with respect to the Reminiscences before us, posterity should be warned not to take them as the record of an average geologist of our times; for while all notable men are of their own pattern, Pumpelly's life has been the very extreme of individuality. Furthermore, contemporary parents of boys who gather minerals and fossils should, in spite of the disregard of America's leading educator's advice shown by our protagonist in the training of Raphael junior, beware of letting their sons embark upon an erratic education of the kind here set forth, in the hope that they will repeat the extraordinary career to which it led; unless they miraculously possess a Pumpellian heart, head and body—a pure and guileless heart, a clear and sagacious head, and a strong and courageous body; and of that rare endowment our sons have not one chance in many thousands.

Aldrich's "Bad Boy" was a little chocolate saint along side of young Raphael in his native New York town of Owego about the middle of the last century, where his piratical adventures, after reaching the high level of a stabbing affray in a quarrel over the division of booty among the members of the gang, were cut short by a wise mother's appeal to family pride, clinched by a more corporeal argument. A few years later a daring climb up the cliff of West Rock at New Haven, where the lad was attending a preparatory school, ought alone to have qualified him for admission to the geological course at Yale, had he not soon afterwards, on reaching the responsible age of seventeen, suddenly decided to forego the advantages there offered and, improving vastly on his grandfather's trite device of entering upon a life of adventure by running away to sea, announced to a well-selected one of his two parents that he wished to study in Germany. She, after the manner of her tactful kind, presented the proposition to her husband, who, after the fashion that has prevailed with men in his difficult position since the days of Eden, assented; and in 1854 mother and son crossed the Atlantic in a sailing vessel to Hamburg.

Hanover was selected as a first station of educational progress, and there two professors were promptly chosen; one was a riding

[1] *My Reminiscences.* By RAPHAEL PUMPELLY. New York, Henry Holt and Co. 1918. With illustrations and maps. Two vols., 844 pages, numbered consecutively.

master, the other a fencing master. Under the latter the young man became so mighty with the "palash" that he wounded to the death a young English opponent; whereupon, instead of vaingloriously seeking more victims, he gave up fencing. His foreign professors included, besides the two "Ordentliche" above named, two "Ausserordentliche" in the persons of a landlady's daughters, who gave lessons in German, cards and dancing, with well conducted practical exercises. The youthful Raphael also met von Roemer and was shown his fossils; and he saw something of the Hanover Polytechnic students, of whom the most capacious exceeded four fold and more the untrained young America's modest maximum of twenty Schoppen at a sitting; but a single season of such carousing was his first and last; its excesses had no attraction for him. Indeed, in this and other lines his education seems to have been conducted on a strictly experimental basis and to have led to wise conclusions: proficiency was repeatedly reached in one art or another, but if the acquired art proved undesirable it was given up and another was tried. The young man therefore had all manner of adventures, pleasant and unpleasant; things were always happening to him. He tramped along the Rhine, collecting rocks and minerals; he rode over the Taunus hills with a fair American companion; he secretly pawned his mother's watch to a Jew at Marburg to get money for railway fares; and he tried his luck on the gambling tables at Wiesbaden. Then after a summer trip in Switzerland, of which little is told, mother and son went to Paris for the winter; manifestly his European education was becoming cosmopolitan.

The French capital proved attractive in various directions. Soon after arriving there, research led him to pick up a fine two-inch Brazilian topaz for a couple of francs from a dealer on the quais. The youth always had the luck with him. A little later he declined the cajoleries of a beauteous and tearful actress, and made instead a lasting friendship with an octagenarian baroness. Truly in friendship-making he had a magnificent and enviable capacity, and always chose from among the best: but the nonchalance of his daily doings was also magnificent, and is equalled only by the naïveté of the narrative in which the daily doings are recorded.

From Paris he went to Italy, still accompanied by the faithful mother, whose apron strings were slow to untie, whichever way he pulled them. At Naples, it came over him that he was not securing the education for which he had crossed the ocean—but on this point we venture to disagree. He climbed Vesuvius and gathered its minerals; he exhausted the family letter of credit, but soon prevailed upon a discriminating banker to advance needed funds; he went to Rome and had an interview with the Pope; and then to Florence. There waking one morning with a wish to wander forth in search of new educational experience, he took leave of his mother for a day or two and set out for Leghorn, with a letter of credit in his pocket for baggage. By the merest chance he went from Leghorn to Corsica, where he spent four months like a knight-errant in the Middle Ages; first enjoying an idyll—platonic—with a forester's young French wife, who sang to him of spring and youth; then roving over the wild mountains with shepherds and bandits galore; meanwhile keenly using his eyes and writing a few explanatory letters to his mother, which the trusty mountaineers failed to post.

Finally returning to Italy, as thoughtless as Theseus though with no Ariadne, he found his distressed parent, who instead of classically leaping from the Leghorn rocks, had as fruitlessly set the police looking for her lost boy all over Europe. She embraced but did not upbraid him, and the happy pair went to Vienna, where education was again taken under consideration; and from Vienna, on the advice of the osculatory old Noeggerath, the youth of nineteen went to Freiberg, with the beginnings of a beard that became famous in later life. On the way there at Dresden the apron strings were at last untied; the mother turned homeward alone and the son turned seriously to his studies—at least as seriously as any one studied in the Freiberg of that

time. But Corsica had charmed him; he revisited that romantic isle the following summer, and this time carried back the famous Mouflon, hero of great adventures, the telling of which in print to the invisible public can not, however, compare with the oral recital, not many years after the event, to a group of admiring boys around a camp fire in the woods of upper Michigan.

Let no one imagine that a glance over these selected items can replace the reading of the delightful autobiography which they introduce. What is here too briefly told is only a curtain raiser to the kaleidoscopic life led by this fascinating boy after he reached manhood. No abstract can do justice to his thrilling adventures as a mining engineer in Arizona—amazing revelations of the conditions that existed when there really was a western frontier; had Beadle, a famout littérateur of that time, known them, they would have made him despair over the poverty of his dime-novel inventions. Mining and smelting in Arizona were followed by geological explorations in Japan and China; it was in that epoch that our hero during a smallpox delirium, playfully fired his revolver, which had been, Arizona-fashion, left handy under the mattress, at his Chinese nurse, who thereupon selfishly resigned his post. The winter journey homeward across Siberia in a sleigh, during which, as a chapter-heading might put it, "A whiff of cigarette smoke passes the time o'day," is not likely to be repeated by the modern traveler, who finds even the Trans-Baikal express too slow. Then came a period of conventional life in New York where some commonplace years were passed; and this was followed by a humdrum engagement as professor of mining at Harvard; but very little did the professorial Pumpelly of those days resemble the customary philosopher plodding across the Common to a lecture, or the expectable mathematician trudging through the Delta after a faculty meeting. Indeed, it was credibly reported at the time that a street-urchin—a "mucker" in the slang of Harvard Square—on seeing this strange apparition in felt hat, long flowing beard, velveteen suit and riding boots, cantering along Kirkland Street, stopped in astonishment, exclaiming: "Golly, what a swell!"

Naturally enough the cantering gait, which so well suited the apparition, soon carried him out of Cambridge and into all parts of the country, as mining engineer, state geologist, director of the Northern Transcontinental Survey, and otherwise; until in 1903–04 he welcomed the approach of old age by conducting a rare journey of exploration, a Carnegie-Institution search for primitive man, into central Asia. Ten years later an excursion was made to Arizona: in the shadow of the loss of wife and mother, the father with son and daughters, who left their own children at home to make themselves boy and girls again, visited the frontier of 1860, where desperados then dwelt and where railroads, hotels and automobiles now flourish locally in the wide arid spaces. "Incidents" occurred of course, such as the near-loss of a toe, and a possible death from thirst in a dry stream bed; but these little affairs did not prevent a deep appreciation of the great empty wilderness with its glaring days of vast distances, and its calm nights below the starlit vault of the cloudless heavens. And from the desert the septuagenarian, once the boy pirate of Owego, the knight errant of Corsica, the student of Freiberg, the Arizona miner, the traveler in the Far East, the expert geological surveyor, the archeological explorer, all reaching their culmination in the genial grandfather, returned to his home in Newport to write his "Reminiscences." There his friends now find him in beautiful serenity. There the good wishes of many greatful readers attend him.

W. M. D.

PROFESSOR WILLIAMS AT YALE[1]

CORNELL and Yale are singularly linked in the life of Henry Shaler Williams. Professor Williams was born at Ithaca, graduated from Yale, then returned to Ithaca to teach at

[1] Address by Herbert E. Gregory, representing Yale University at the exercises in memory of Henry Shaler Williams, held at Sage Chapel, Cornell University, October 20, 1918.

Cornell. In 1892 he is again at Yale, returning in 1904 to Cornell, where his life work was finished. Six years of his young manhood were spent at Yale in undergraduate and graduate studies and eight years as professor of geology. Just twice that time was devoted to active service at Cornell. Yale thus shares with Cornell the prestige which comes from a great scientific name, and it is fitting that the two universities should join in commemoration of the life and services of Professor Williams.

The Yale records reveal little of Williams as an undergraduate except that his class work was well done, but it is easy to picture the boy taking walks along the shore of Long Island Sound collecting materials, bringing them home for study, and building the foundations for penetrating observation which later yielded such large returns to science. For Williams, the graduate student, the eager boy already devoted to the search for the hidden meaning of natural phenomena, the distinction between teacher and student broke down. Williams was a member of a small company of sympathetic, earnest men—faculty and students—who together carried on their investigations. The quality of his work as a graduate student is indicated by his thesis for the doctorate, which is not the elaboration of a task assigned by an instructor, but an exhaustive study and a significant contribution to science.

In 1892 Yale was confronted with a difficult problem. It became necessary to select a successor to James D. Dana, America's foremost geologist, and to fill the chair which for nearly a century had been made famous by Silliman and Dana. There were many able geologists in the country, but Professor Dana insisted on a man who combined preeminent attainments with personal character and faith, for the task in hand was not merely to present the facts and principles and methods of geology to successive groups of students, but to stand as an interpreter of the truths of nature. The doctrine of evolution in many quarters appeared to be in conflict with Christian faith. Great truths were to be reconciled and a great man was demanded for the task. Dana chose Professor Williams. And so it came about that after twenty years of distinguished service at Cornell, Williams came to Yale as Silliman professor of geology. He came at the time when the great "Manual of Geology" was taking final form, and took part in the statement of the theory and facts of evolution which brought the teaching of the "Manual" in harmony with the leading scientific thought of the day.

In the early nineties at Yale little room was found in the curriculum for geology. The subject was offered only to juniors and seniors and was so restricted that relatively few men could elect it. The records show that during the first two years of Professor Williams's professorship students elected geology for no particular reason, but soon the class was found to consist of men who were seriously interested in problems of nature and their bearings on life. Williams was not a "popular" teacher, as voted by the senior class. He knew no tricks of the lecture platform and cared little for applause. He found it difficult to formulate dramatic situations and impossible to be dogmatic; his statements were accompanied by qualifications and exceptions. Williams loved the truth as few men love it; he was not content with half truths. The effect of this style of teaching was easily seen in the reaction of the class. At first the teaching seemed confusing; few clear-cut sentences could be written in a note book and cramming for tests on the basis of catch phrases was a very difficult task. Before the end of the course, however, the class realized that under the name of geology they were learning the greatest lesson open to men—the method of weighing evidence and thus arriving at truth. Many students of Williams have duplicated my experience. I came in from classes in philosophy and classics and was surprised at the method and content of the course. I asked myself the question: Is this geology? I had thought that geology was the study of rocks and fossils and valuable minerals, but found it a method of clear thinking—a road to the fundamentals of intellectual and spiritual life.

As presented by Professor Williams geology was not a guide to making money or to the collection and labelling of natural objects. It was a method of adjusting one's thinking to great truths. The many students who came under Williams's influence learned to view the world in a new light. Space and time and matter and living organisms took on new meaning, and somehow assumed a spiritual aspect, so that knowledge was not mere acquisition of facts and methods, but a something which ennobled its possessor. Someway also the search for truths untarnished by mercenary or selfish motives tended to dissolve doubts and to land one on a solid foundation. Teaching which produces such results is a man's work.

Williams exerted a large influence through an advanced course in the philosophy of life and organisms—a course sometimes enrolling a dozen, sometimes one hundred or two hundred, as arrangement of the curriculum allowed choice on the part of students. The teachings of this course became campus discussion, and entered into the thinking of graduates, undergraduates and faculty. Its value was so obvious that after Williams returned to Cornell the course was again organized and is now one of the prominent features of the Yale curriculum.

At Yale we remember Professor Williams as a man wholly unselfish, who would not magnify his importance, who would not fight for what might be considered his rights. He was ready to use poorly equipped laboratories and class rooms and to take undesirable hours for teaching in order to advance the work of others. He freely shared his great fund of knowledge and experience and seemed more interested in the success of others than in his own success. Unselfishness and devotion to truth are the traits we remember in Williams. They characterized his personal relations, his teaching and his writing. More than any man of my acquaintance he exemplified the text: "Ye shall know the truth and the truth shall make ye free."

Williams's work lives in his writings and perhaps even more in his students, but his death is no small loss. Unselfish teachers of truth are rare in any generation.

HERBERT E. GREGORY

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SCIENTIFIC EVENTS

AN INSTITUTE OF PHYSICAL AND CHEMICAL RESEARCH FOR JAPAN[1]

THE outbreak of the great war in 1914, which at once cut off the import, mainly from Germany, of dyestuffs, drugs and other products of daily necessity, and at one time almost gave rise to a panic in business, was responsible for producing a profound change in the mental attitude of the government officials, the business men, and, in fact, the whole nation towards science. Those who had in vain been preaching the supreme importance of cultivating science with all activity and pleading for public support now saw at once that the right opportunity presented itself, and lost no time in drawing up a definite plan for an institute of physical and chemical research—a plan which, though not ideal, was deemed to be practical and to meet the most urgent need. This, fortunately, obtained the cordial support of some of the most influential and public-spirited of the business men, particularly of Baron Shibusawa, and afterwards also of the government of which Count Okuma was at the time premier.

According to the plan, which was ultimately adopted, a fund of 5,000,000 yen (10 yen = £1) was to be raised by public subscription. Of this sum just about one half has already been promised, and is being paid in, almost wholly by those who have either commercial or industrial concerns in Tokyo and Yokohoma. The other half is, with good reason, expected to be contributed within a few years by those in Osaka, Kobe and other large and wealthy cities in the southwestern districts. The plan also included an application for a government subvention, and, in accordance with the bill passed by the Diet in its 1915–16 session, the government is giving the institute a subvention of 2,000,000 yen in ten years, whilst H.M.

1 From *Nature*.

the Emperor has made a gift of 1,000,000 yen for promoting the object of the institute. The total fund, supposing that the public subscription comes up to the expected sum, would thus amount to 8,000,000 yen, of which about 2,500,000 yen has to be invested in land, buildings and equipment. But since the interest accruing from the fund is calculated to exceed the annual expenditure for the first six or seven, or even more, years, when the activity of the institute can not of necessity be very great, it is expected that at the end of ten years there will be left over a fund of about 6,000,000 yen, which, calculated at 5 per cent. interest, would yield an annual income of 300,000 yen. To this extent, herefore, the institute would be self-supporting, and it is roughly estimated on this basis that the number of staffs of all grades and of mechanics, laboratory boys, etc., would be between 100 and 120 in all. But it is evident that the institute must grow in both size and activity, and that, therefore, the above income would soon be found to be inadequate to meet the necessary expenses demanded by this growth. As the institute grows in activity, however, its importance will be more and more evident, and it is believed that there would then be no great difficulty in obtaining more money.

THE DEPLETED HERDS OF ENGLAND, FRANCE AND ITALY

LARGER importations of meat and pork products from the United States, thus lessening the slaughtering of native animals, will be the most effective means of restoring the depleted animal herds of the United Kingdom, France and Italy. This is the information recently received from Dr. Vernon Kellogg, of the United States Food Administration, while in France on official business. Dr. Kellogg declares that the losses in cattle in France and Italy are especially serious, not only on account of the meat and milk ordinarily obtained from this source, but also on account of the loss of the services of cattle, through depletion, which are used as work animals on farms in both countries. He writes:

The most recent statistics on animal herds, indicating the number now existing in allied countries, show a loss of cattle in France of 17 per cent.; in Italy of 14 per cent., with the United Kingdom showing no loss; sheep and goats, France, 41 per cent.; Italy, 1 per cent.; United Kingdom, 10 per cent.; pigs, France, 49 per cent.; Italy, 12.5 per cent.; United Kingdom, 25 per cent.; horses and mules, France, 37.5 per cent.; Italy, 25 per cent.; United Kingdom, not including animals not employed in agriculture, 4.5 per cent.

The losses in cattle in France and Italy are not only serious on account of the meat involved, but are especially serious on account of milk and also of work, as cattle are used largely in both countries as work animals on the farms. It is highly important that the herds be restored as rapidly as possible, which can be done most effectively by larger importations of meat and pork products from America to lessen the slaughtering of native animals.

The French and Belgian people now being released from formerly occupied territories are demanding and needing increased amounts of food over the former relief ration in order to restore health and strength so as to be able to work, thus making larger demands on imports from America.

I have now been in France three weeks, eating in restaurants and hotels of all grades, and I have had butter on the table once and a total of six lumps of sugar. Saccharine is universally used in coffee and tea. The smaller sugar ration is mostly reserved for cooking.

THE USE OF NITRATE DURING THE WAR

FACTS concerning the importation and use of nitrate during the war period, hitherto suppressed for military reasons, have been made public by C. H. MacDowell, director of the Chemicals Division of the War Industries Board.

In the fall of 1917 the Congress appropriated $10,000,000 to be used by the Agricultural Department in importing nitrate of soda to be sold by them to the farmers at cost. This was later made a revolving fund. Under this the War Industries Board procured for the Department of Agriculture some 109,000 long tons of nitrate for shipment from Chile during the winter and spring. Owing to disturbed shipping conditions in the early spring, it was impossible to bring in for February-March arrival the tonnage expected, and with the

needs developed by the expected spring offensive of the Germans, it became necssary to divert to France a large tonnage of nitrate for manufacture of explosives in that country and for further increasing production of explosives in this country for use in France. This immediate need made it impossible for the Department of Agriculture to secure boats sufficient to bring in the full 109,000 tons so that 66,778 tons was actually imported in time for use by the farmers for spring planting.

Owing to military necessity, publicity could not, of course, be given to the reason of the non-arrival of the nitrate sold to the farmers, and this inability to deliver was the cause of considerable felling on the part of users of nitrate of soda. The military necessity was the greatest one and the planters who were unable to get the nitrate were in this way contributing to the supply of explosives in France, which later led to the winning of the war.

The nitrate of soda situation in the United States up until about the first of August was a serious one, although every explosive and chemical plant was kept supplied with sufficient nitrate to maintain full operations at all times. This was done by drawing from government arsenal reserves and by transferring stocks from fertilizer manufacturers and other holders to plants when stocks were about exhausted. Owing to the shortage of nitrate, it was deemed wise to ask the importer to discontinue sales of nitrate to fertilizer manufacturers other than for the making of sulphuric acid, and after the first of July all consignments of nitrate arriving in the country sold to such manufacturers were commandeered by the Ordnance Department and turned over to munitions and chemical manufacturers. These contracts thus handled were made between the importers and the fertilizer people in the fall of 1917.

Immediately on the signing of the armistice, all restrictions were taken off of the importers as far as sales of nitrate to fertilizer manufacturers and agricultural users was concerned, so that there will be no difficulty in supplying the entire needs of the United States for agricultural use for spring planting.

Nitrate of soda is the foundation of smokeless powder and high explosives as well as for other needed chemicals, and the purchase and importation of nitrate are conducted by government through the War Industries Board in cooperation with the importers formerly handling this material, the importers buying in Chile as in times past. The government received their nitrate through the importers at cost and the profit charged by the importers to private users was controlled by the government so that uniform cost to all users was secured, this cost being based on the average monthly cost in Chile, plus the freight storage, exchange, and other elements of cost.

A committee known as the Nitrate Committee of the United States was established with offices in New York and a New York representative of the War Industries Board represented that board in the offices of this committee. Government needs for nitrate were increasing rapidly and the 1919 requirements would have been very large. During the entire period of the war all needed nitrate was secured and there was no let up in the manufacture of war materials depending upon this article.

SCIENTIFIC NOTES AND NEWS

PROFESSOR WALLACE CLEMENT SABINE, professor of physics at Harvard University and formerly dean of the Lawrence Scientific School, died on January 10, aged fifty-one years.

DR. SIMON FLEXNER, director of the Laboratories of the Rockefeller Institute for Medical Research, has been elected a corresponding member of the Société des Hôpitaux de Paris, and has had the title of Officier de Legion d'Honneur conferred upon him by the French government.

THE American Phytological Society at its tenth annual meeting, held in Baltimore, December 23–28, elected the following officers: *President,* C. L. Shear, U. S. Department of Agriculture; *Vice-president,* I. E. Melhus, Iowa State College, Ames, Iowa; *Secretary-Treasurer,* Geo. R. Lyman, U. S. Department

of Agriculture; *Councilor,* Donald Reddick, Cornell University. Dr. Lyman was also elected Business Manager of Phytopathology for the year.

The following were elected officers of the Association of American Geographers at the Baltimore meeting: *President,* Professor Charles R. Dryer; *First Vice-president,* Dr. Herbert E. Gregory; *Second Vice-president,* Dr. Isaiah Bowman; *Secretary,* Dr. Oliver L. Fassig; *Treasurer,* Mr. Francois E. Matthes; *Councilor for three years,* Professor Eliot Blackwelder.

Professor C. K. Leith sailed for France on January 1 to act as mineral adviser for the U. S. Peace Commission. The party included Chairman B. M. Baruch, of the War Industries Board; Chairman Vance McCormick, of the War Trade Board, and Walter Tower, of the Shipping Board. For the past year Professor Leith has been in charge of the joint mineral work of these boards, with special reference to regulation of imports and exports.

Brigadier General William S. Thayer, who has been serving in France, will, on his return to this country within a few days, resume his duties as professor of medicine of the the Johns Hopkins Medical School. Dr. Thayer will take the place of Dr. Theodore C. Janeway, who died several months ago while serving on the staff of the Surgeon-General.

Major John M. Berry, formerly epidemiologist in the New York State Department of Health, has recently been promoted to the rank of lieutenant colonel.

Dr. Karl T. Compton, assistant professor of physics in Princeton University, has returned after a ten months' work for the Research Information Service in the capacity of associate scientific attaché to the American Embassy in Paris.

Dr. Ralph E. Wilson has left his work as an aeronautical mechanical engineer, Bureau of Aircraft Production, to accept a position as astronomer, Department of Meridian Astronomy, Carnegie Institution of Washington, stationed at the Dudley Observatory.

Mr. Neil M. Judd, assistant curator of anthropology, U. S. National Museum, has returned to Washington after eleven months' service in the aviation section of the national army.

Dr. Oscar Harder has resigned his position in the research department of N. K. Fairbanks Co., Chicago, Ill., to accept a fellowship at the Mellon Institute of Industrial Research, Pittsburgh, Pa.

Assistant Professor Samuel D. Graydon, recently of the department of descriptive geometry and mechanical drawing, and who has been in continuous service at Stevens Institute of Technology as assistant professor since 1892, has been retired under the provisions of the Carnegie Foundation.

Dr. L. Baumann, assistant professor and director of research in the department of internal medicine of the University of Iowa, has resigned his position to take effect at the end of the present college year. He will live in New York City.

Mr. J. A. McClintock has resigned his position as extension specialist in cotton, truck and forage crop diseases, to which he had been appointed under a joint project between the U. S. Department of Agriculture and the Georgia State College of Agriculture.

At the request of the U. S. Food Administration, the Rockefeller Institute for Medical Research has granted a leave of absence to Dr. Israel S. Kleiner in order that he might take charge of Professor Lafayette B. Mendel's work at Yale University while the latter is attending the meetings of the Inter-Allied Food Commission abroad.

Professor Percy F. Frankland is retiring from the Mason chair of chemistry in the University of Birmingham at the end of the current term. In accepting the resignation with great regret, the council has expressed to Professor Franklin its thanks for valuable services rendered to the university during the past twenty-four years.

At the annual general meeting of the Faraday Society of London, held on November 12,

the following officers were elected: *President,* Sir Robert Hadfield, Bart., F.R.S.; *Vice-presidents,* W. R. Bousfield K.C., F.R.S., Professor F. G. Donnan, F.R.S., Dr. Eugene Haanel, Professor A. K. Huntington, Dr. T. Martin Lowry, F.R.S., Professor Alfred W. Porter, F.R.S.; *Treasurer,* Robert L. Mond; *Council,* G. S. Albright, W. R. Cooper, Dr. C. H. Desch, Dr. J. A. Harker, F.R.S., Emil Hatschek, Cosmo Johns, Harold Moore, E. H. Rayner, Dr. George Senter, Cav. Magg, E. Stassano.

AT the annual meeting of the Washington Academy of Sciences held at the Administration Building of the Carnegie Institution on January 14, 1919, the retiring president, Dr. Lyman J. Briggs, delivered an address on "The resistance of the air."

A JOINT meeting of the Washington Academy of Sciences and the Chemical Society of Washington was held on January 9, when Dr. F. B. Power, retiring president of the Chemical Society, delivered an illustrated address on "The distribution and character of some of the odorous principles of plants."

THE annual Darwin Lecture of New York University will be given on February 12 by Dr. C. L. Bristol, of the department of biology. In connection with the lecture a series of motion pictures of marine life made in Naples, Italy, will be shown by Dr. R. L. Ditmars, curator of reptiles, New York Zoological Gardens.

A CABLE message announces the death in Rome, on December 31, of David Lubin, of San Francisco, founder of the International Institute of Agriculture, and the American representative on its permanent board. He was born in 1841, and was formerly a merchant in Sacramento, where early in his career he made a fortune. He then devoted himself to economic reforms and was responsible for the establishment at Rome of an international agency for collecting official and reliable information from all parts of the world as to the acreage, output and ability of the cereal crops.

THROUGH an anonymous donor The Long Island College Hospital (Hoagland Laboratory) has had placed at its disposal a farm for keeping animals used in research. Already work and experimentation in fowl influenza (roup), diphtheria and chicken-pox have been begun.

UNIVERSITY AND EDUCATIONAL NEWS

PROPOSALS for extending the accommodation and equipment of the department of pathology and bacteriology at Leeds University have been approved. It is hoped to concentrate the whole of the bacteriological work of the city in the additional accommodation provided by adapting the premises adjacent to the medical school.

THE Massachusetts Institute of Technology plans to offer to students who have substantially completed courses leading to the degree of bachelor of science in chemistry or chemical engineering, an opportunity to enter the school of engineering practise in February. Two terms of preparatory work will be given at Cambridge, the first beginning February 17; it is expected that the work at the practise stations will begin about October 1, and continue until the following May. The general plan of the course will be the same as that carried out while the school was in operation just before the opening of the war.

THE REV. EDWARD P. TIVNAN, S.J., professor of chemistry and regent of the school of medicine, Fordham University, has been appointed president of the university, to succeed the Rev. Joseph A. Mulry, S.J.

THE departments of descriptive geometry and mechanical drawing and of mechanism and machine design at Stevens Institute of Technology have been combined to form a new department of machine design, of which Franklin DeR. Furman is professor and head. The work of the department has been organized with two divisions—one the mechanism division, in which William R. Halliday is assistant professor, and the other the mechanical drawing division, in which Edwin R. Knapp is professor and Samuel H. Lott, assistant professor. The following changes in rank have been made at the institute: Louis A. Hazeltine,

acting professor in the department of electrical engineering, to professor; Robert M. Anderson, acting professor in the department of engineering practise, to professor; Lewis E. Armstrong, instructor in the department of mathematics, to assistant professor.

Mr. Lester Yoder, formerly with the chemical section of the Agricultural Experiment Station of Iowa State College, is now at the U. S. Technological School, Carney's Point, N. J.

The chemistry department of the University of Nebraska announces the following additions to its teaching staff: Dr. Horace G. Deming, of the University of Illinois, as professor of chemistry in charge of general and physical chemistry; Mr. B. Clifford Hendricks, of Peru, Nebr., State Normal School, as assistant professor of chemistry; Mr. T. J. Thompson, of Kansas Wesleyan University, as instructor in organic chemistry.

DISCUSSION AND CORRESPONDENCE

THE LILLE SOCIETY OF SCIENCES

To the Editor of Science: I wish to call the attention of American scientists to the following extracts from a letter received from Dr. Charles Barrois, professor of geology at the University of Lille and actively interested in the Society of the Sciences of Lille. Dr. Barrois writes:

> For four years I have been cut off from the number of the living, reduced to servitude, without receiving a letter or a scientific book; I have not been able during this time to communicate with anybody in the world, nor to have any news of my family. That has been harder to me than physical sufferings and bombs.
>
> My geological institution has been twice demolished by bombs, but I was able to save the collections from the débris and they were respected by the Germans. Our library of the Society of Sciences was unfortunately burned so that I am much embarrassed in my work; the books of the Public Library were also burned, those of the university were saved, but that was the least important library.
>
> I am working at present to build up again my university, our Geological Society of the North, all the members of which are scattered, ruined or killed. I do not yet know if I shall succeed; books are necessary, and money is necessary to continue my publications and I fear it can not be obtained in France where they are much impoverished. I look sadly at the manuscripts of my confrères, entrusted to my care for publication. . . . I am quite a little disconcerted at being reduced to mendicancy in my old days, for our learned societies, but the American devotion and generosity have been shown so great in these latter days, that we believe we can be assisted by them openly.

If any one has any books or specimens that they think would be of assistance to Dr. Barrois and his associates in connection with the Library and Museum of the Society of the Sciences, the Smithsonian Institution will be very glad to transmit them to the society at Lille.

Charles D. Walcott

ROOT PRESSURE AND ROOT EXUDATION

A recent note in Science by Professor Kremers[1] upon the use of dahlias for experimental work upon osmosis reminds the writer of his use of the same plant for the demonstration of root pressure and the exudation of water in quantity. The growth from the tuberous roots is vigorous and in a short time is ready for the setting up of the experiment. The quantity of water exuded and the pressure are adequate for a thorough demonstration of these phenomena as outlined for example in Ganong's "Plant Physiology" and fully equal to the best plants which the writer has used in such demonstrations.

In this connection the writer wishes to express a thought which has been more and more impressed upon him in his work as a teacher of physiology, pathology and even morphology of plants. Each institution, and especially is this true of the smaller ones, is working out its technical problems in an isolated fashion, often repeating unprofitable experiments which have been found by other institutions to be unsuccessful. In other cases especially useful plants or types of ap-

[1] "Experimental Osmosis with a Living Membrane," Edward Kremers, Science, N. S., Vol. XLVIII., No. 1250, December 13, 1918, p. 599.

paratus are in use, the knowledge of which would be of great value both as time savers and as means of encouraging better teaching of botany. Why should there not be a free exchange of such methods and ideas through the medium of publication in one of our universally distributed journals such as Science? The writer suggests a special department, in such a magazine, devoted to technique where not only successful experiments in teaching are reported but also where negative results shall be stated. A magazine devoting space to such a department would do much toward advancing the technique of science. It may be objected that such notes do appear from time to time in various magazines. This is true, but the writer is convinced that only a very small number of such notes appear as compared with the total number of helpful suggestions which should be the common property of men working in the same science. In this branch of educational work at least there should be no selfish "patent" upon such matters to be used as a "drawing card" for the department or institution. Such a department devoted to notes upon technique would save all teachers of science much time which they now spend in fruitless testing out of methods which some other institution has already demonstrated to its own satisfaction to be unsatisfactory. There would also be a marked improvement in the teaching in the smaller institutions at least, by the introduction of newer and better technique.

Ernest Shaw Reynolds

Agricultural College, N. D.

GENERIC LIMITATIONS

The deductions of Professor Robertson on this subject in Science for October 11 seem to be based upon questionable premises. Of the factors which influence the number of species in a genus, he mentions only the antiquity of the group. Other important factors are: specific limitations; size of group considered; area, location and diversity of territory included; degree of perfection of our knowledge of the species. These are illustrated in the following list:

	Species	Genera	Average	Poales
Cat. N. Am. Pl., Heller, 1900[1]	16,673	2,027	8.2	6.2
Gray's Manual, 7 ed., 1908.	4,079	1,001	4.1	6.7
Fl. S. E. U. S., Small, 1903.	6,364	1,494	4.4	6.7
R. Mt. Man., Coult. & Nels., 1909	2,733	649	4.2	4.2
R. Mt. Fl., Rydberg, 1918	5,897	1,038	5.7	7.3
Fl. Colo., Rydberg, 1906	2,912	702	4.2	4.7
Fl. N. Mex., Woot & Stand, 1915	2,903	848	3.4	4.1
Pl. of Conn., 1910	1,942	621	3.1	5.2
Fl. Mich., Beal, 1892	1,746	554	3.2	4.2
Fl. N. D., Bergman, 1918	963	448	2.2	3.1
Fl. of Fargo, N. D., 1918	520	295	1.8	2.3
Fl. Vigo Co., Ind., Blatchley, 1896	853	423	2.0	2.6
Bees of N. Mex., Ckll., 1906	561	72	7.8	—
Bees of Boulder Co., Colo., Ckll., 1907	175	42	4.1	—

It will be noted that the averages vary in proportion to size and diversity of territory. On account of this and narrow specific limits Rydberg's "Rocky Mountain Flora" is one of the highest, notwithstanding his narrow generic limits. New Mexico runs low on account of many Mexican genera entering the state.

Since the bees are but a suborder we may scarcely compare them with larger groups. The *Poales* are perhaps the most nearly comparative group of the plants, although relatively larger. The genus *Carex* is more nearly comparable than any other to the bee genus *Andrena,* the number of species being about equal.

From Robertson's list we find the bees of New Jersey are 2.7 per cent. of the total insect list, while those of Carlinville are 23.0 per cent.; similarly, the Lower Aculeata are 4.9 per cent. and 16.2 per cent. From this and our knowledge of the extent of his work on these groups we might conclude the averages for other groups to be low on account of their many unknown species.

Recognition of many small genera would seem to necessitate the elevation of old genera and larger groups to higher rank, thus greatly increasing group names. Classification serves two purposes. Names have been often called "handles," while the system presents the state of our knowledge of relationships. For the

[1] Includes varieties; others do not.

taxonomist, large numbers of names present little difficulty because he uses them frequently, but for others it is different. Thus probably not less than 90 per cent. of science workers are "beginners" and the others, outside of their special fields, are also. The writer believes in the recognition of small groups but doubts the necessity of forcing them upon every one. Would it not be feasible to have our floras and faunas in two parts, the first leading to collective groups, the second continuing through the smaller groups?

O. A. Stevens
Agricultural College,
North Dakota

FIREFLIES FLASHING IN UNISON

To the Editor of Science: I was much interested in Mr. Fremont Morris's letter regarding the "Fireflies Flashing in Unison" on page 418 of the last volume.

I was employed by the Philippine Bureau of Forestry during 1902 and 1903. In the spring of 1902, I was stationed for some weeks at Pagbilao, Tayabas Province. It is on a small tidewater river about half or three quarters of a mile from Lagimanoc Bay. I had occasion to go across this bay on February 22 and did not return until after dark. As the banca in which I was travelling entered the mouth of the river, I was attracted to the flashing of the flies which appeared in great numbers a short distance above the mangroves which covered both banks of the stream.

The majority of the fireflies were flashing in unison but there were some which did not time their flashes with the majority. The light from the fireflies with the reflection of the light from the water made a very distinct illumination and one never to be forgotten by one who has seen it.

P. T. Barnes
Pennsylvania Department of Agriculture

NEGATIVE RESULTS FROM ATTEMPTED QUEEN BEE MATING IN A DOUBLE TENT INCLOSURE

Following out suggestions from previous work of Cole and Miller, Rhode Island, and from bee behavior observations in an artificially lighted double tent at University of Wisconsin, by the writer, an attempt was made the past season to mate a Virgin queen bee in an available double tent inclosure.

The tent was made of double canvas, 4 feet in diameter, 7 feet high at peak, with about 8 inches space between the canvas walls.

A nucleus, containing workers, drones and a five-day-old virgin was placed in the tent and observations taken.

No natural mating flights occurred. The virgin appeared to fly naturally in the tent, returning unaided to the hive, when removed from the nucleus and thrown into the air. The drones appeared to fly naturally, more so at first than after several days confinement in the tent.

The queen failed to mate.

L. V. France
University of Minnesota,
University Farm, St. Paul

SPECIAL ARTICLES

SPECTRUM PHENOMENA DUE TO MOVING MOTES

In connection with my regular work I incidentally came upon a curious phenomenon which seemed to repay special investigation. To describe it, it will be advantageous to first indicate the disposition of apparatus used, as is done in Fig. 1. Here L is a pencil of white light (preferably from a collimator and wide slit) impinging on the thin cylindrical glass shell G, about 10 cm. in diameter and containing a solution of mercury-potassic iodide, about half an inch deep and not quite concentrated. The rays are thus both refracted and dispersed, and on emerging enter the strong objective of a short-range telescope (magnification above 15) of which PP' is the principal plane and $r'b'$ the narrow spectrum seen in the ocular of the telescope. Properly focusing the latter, the spectrum may be contracted to a vividly colored vertical line.

If now a strong direct-vision grating g is inserted in front of the objective, and the telescope is focused anew, a *sharp* solar spectrum may be obtained. This was a surprise to me, as the cylinder[1] G, though thin and clear, was

[1] The present use of a cylinder as a collimator is well worth noting.

obtained from samples of ordinary glass shades, such as are prized by the lovers of stuffed birds. In other words, the cylinder supplies its own slit within, as at r or b in the figure, by refraction. With a narrow beam of sunlight no collimator is needed.

The spectrum will now be found to be filled with short, slender, horizontal shadows moving endwise in a common direction, but at different speeds. On pushing the ocular in somewhat further, these shadows become sharply defined lines, all nearly horizontal, of all lengths from mere points to black lines half the length of the spectrum or more. On attentive observation the black lines are seen to

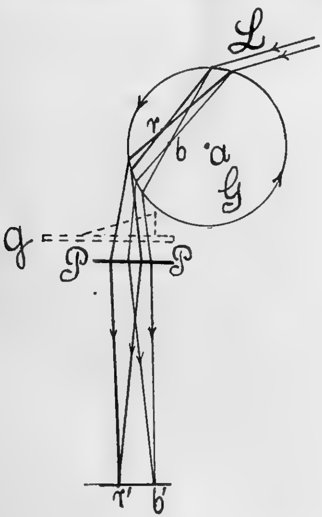

FIG. 1.

be associated with narrow areas of accentuated brightness, so that diffraction patterns are in question. Occasionally a beautiful complete slender spindle-shaped black body with a brilliant narrow frame of light around it, will appear. Arrowheads holding patches on their notched sides, are not infrequent; but as a whole the spectrum has the appearance of being intersected with an interminable array of slow horizontally flying arrows, shot in a common direction from end to end. With regard to the motion, this is more usually horizontally from red to blue; in the lapse of time and in the middle layers always so and not permanently from blue to red. Sometimes both motions were seen to occur together in different levels, the retrograde motion being relatively slow, less pervasive and confined to the top or the bottom layers of the liquid. All degrees of speed occurred from a passage through the spectrum in a fraction of a second, to passages lasting over a minute. Under the latter conditions it may happen that the particles actually stop and then begin a retrograde movement soon to be accelerated in turn. During this period of transition, particles may be seen also to rise and fall, but with relatively great slowness as compared with the usually horizontal motion. Some of the arrows are somewhat oblique to the horizontal. Under rare conditions I noticed a line of light instead of shadow. Breadths differ greatly and would naturally depend on focusing.

Usually the motion persists with apparently undiminished small velocity for hours, so that it much outlasts one's patience. Often a single particle can be observed for a minute or more; but after 10 or 20 hours all particles disappear and the spectrum is clear. From this I concluded that the diffractions are not due to local difference of density, etc., of the solution, as I first supposed, but actually originate in minute solid particles (or in case of other liquids in minute air bubbles) entrapped in the liquid. The slow subsidence and persistence of particles indicates this state of things.

Moreover I found that the initial motion of particles as a whole from red to blue or blue to red, could be controlled by *rotating* the cylinder G on its axis a, either counter-clockwise or the reverse, respectively. Brownian motions are excluded, since these are promiscuous and since the magnification is inadequate. It is difficult to conceive how the angular momenta impressed on this solution can persist for hours within it, after the solution is apparently quite at rest, even if the solution is of large

density (dense enough to float glass). Probably since the internal friction of liquids vanishes with the relative velocity of layers, and since the apparent motions are magnified, there are eventually no frictional torques left to absorb whatever angular momenta may be renewed. The occurrence of direct and retrograde motions at the same time, separated sharply by a plane of demarcation suggests vortices. Above this plane particles move with about the same speed in one direction, below the plane with a very different speed in the opposite direction. A particle which happens to be in the plane in question does not move at all. After a long interval the direction of the motions above and below a plane of demarcation may be found to have reversed, respectively. If a solution is cleared of particles by the lapse of a sufficient time for subsidence, they may be restored by brisk rotation. The number, size, density of color and speed of the particle naturally increase with the violence of rotation.

To conclude: After the cessation of the initial disturbances, the liquid, left to itself and owing to the presence of motes, shows a persistent motion of its middle layers in the general direction of the impinging beam of light, while the motion of the relatively thin layers at the top or bottom (one or both) is usually persistently retrograde, but slow in comparison. This continues, until after the lapse of hours the particles have practically subsided, when the retrograde motion seems to be equally prominent. Even when the liquid is manually rotated clockwise with violence, this impressed motion ceases in a few minutes whereupon the counterclockwise, red-blue motion, in the direction of the impinging beam, sets in vigorously.

It suffices to add a few statistical remarks. The telescope may be adapted for small distance by placing 3 diopter spectacle lenses in front of it. Its external focal plane is then only about a foot off and within the liquid. The rays seen in the ocular of the spectrotelescope may be regarded as coming from a virtual slit within the cylinder; or else, on narrowing the incident beam L to within a centimeter (in case of a cylinder 10 centimeter in diameter), the diffuse internal caustic has already been similarly narrowed down to a short internal spectrum rb in the figure. Hence if the solution rotates slowly about the axis a, particles enter the red (r), and leave the blue (b) end, and are therefore seen sharply in the spectrum travelling from red to violet. The reverse is the case if G rotates in the clockwise sense. The small distance rb is the virtually magnified by the immense dispersion of the grating (15,000 lines to inch) G. Since the rays cross *within* the cylinder, G, the motion from red to blue will also characterize all particles distinctly seen and rotating counterclockwise. Finally, this rotation corresponds in a general way with the direction of advance of the light transmitted through the cylinder.

It would be simplest to refer the cause of persistence to a case of vortical motion in the wake of the beam of light traversing the solution. But the invariable occurrence, in the lapse of time, of motion in the middle layers of the liquid in the direction of the impinging light, no matter how the liquid is artificially rotated in the beginning, leaves this explanation unsatisfactory. Such vortices would not be orderly and persistently equivalent to the effect of a pressure in the direction and of the beam of light. In case of a black body and a solar constant of 3 gram-colories per minute, the energy per unit of volume or the light pressure in question may be roughly estimated at 7×10^{-5} dynes per square cm. Even if but a part of the energy is absorbed by the liquid, this is by no means an insignificant pressure in a medium whose internal friction vanishes with its motion. In fact if the given estimate be treated as a tangential force relative to the surrounding dark liquid, of about .01 viscosity, a speed of 7×10^{-3} cm./sec. (under normal conditions) would correspond to the shear. One may therefore infer that speeds within a tenth millimeter per second, about of the order observed, are not impossible. The very slow but persistent regressive movement at the top and bottom of the layer of liquid remains unexplained. Furthermore I was unable to find any adequate corre-

spondence between the swiftness of the motion and the intensity of the impinging beam. Again, the molecular radiometer, in which the thermal gradient is at the same time a pressure gradient would fall under the same objections. I can only conclude vaguely, therefore that in some way the local vortices evoked by thermal distribution resolve themselves into a persistent ordered rotation[2] of the cylinder of liquid around its vertical axis, with the regressive motion specified confined to one or two relatively thin layers.

CARL BARUS

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[2] In other words, the conditions of hydrostatic equilibrium imply an inclined surface of the liquid with its maximum head in the region of the illuminated part. But such a structure is gravitationally unstable. It is difficult to see, however, why the flow should be an orderly rotation of nearly the whole cylinder of liquid.

AMERICAN SOCIETY OF NATURALISTS

THE thirty-sixth annual meeting of the American Society of Naturalists was held at Johns Hopkins University, Baltimore, December 28, 1918, Vice-president Guy N. Collins in the chair. In affiliation with the society at this meeting were the American Society of Zoologists and the Botanical Society of America.

Illness having prevented the attendance of the treasurer the auditing committee was directed to examine his books and report at the next meeting of the society.

The executive committee recommended that sections 1 and 2 of article III. of the constitution be changed to read as follows:

Article III., Section 1. The officers of the society shall be a president, a vice-president, a secretary and a treasurer. These, together with three past-presidents and the retiring vice-president, shall constitute the executive committee of the society.

Article III., Section 2. The president and vice-president shall be elected for a term of one year, the secretary and treasurer for a term of three years. Each president on retirement shall serve on the executive committee for three years. Each vice-president on retirement shall serve on the executive committee for one year. The election of officers shall take place at the annual meeting of the society, and their official term shall commence at the close of the meeting at which they are elected.

This recommendation was referred back to the executive committee by the society with the suggestion that they consider further the form by which continuity of policy may best be attained.

There were elected to membership: William T. Bovie, Harvard Medical School; Walter B. Cannon, Harvard Medical School; Otto Glaser, University of Michigan; Donald F. Jones, Connecticut Agricultural Experiment Station; Lewis R. Jones, University of Wisconsin; Horatio H. Newman, University of Chicago; Victor E. Shelford, University of Illinois; Theobald Smith, Rockefeller Institute; Alonzo E. Taylor, University of Pennsylvania; Edgar N. Transeau, Ohio State University.

The following program was presented:

Parthenogenesis and sex determination in the white fly: A. F. SHULL and N. R. STOLL.

The evolution of nuclear conditions in Ciliata: M. M. METCALF.

The genetic interrelations of two dwarf perfect-flowered types of maize: R. A. EMERSON and S. H. EMERSON. (Read by title.)

Crossing-over and allelomorphism in the grouse locusts: R. K. NABOURS.

The evidence in favor of a linear order of the genes: T. H. MORGAN.

Reversal of dominance in a meal-moth producing some new phenotypic ratios: P. W. WHITING.

The globe mutation in Datura: A. F. BLAKESLEE.

Some factors in growth correlations: E. W. SINNOTT.

On some growth-changes in the body-form of Mellita: W. J. CROZIER. (Read by title.)

The effects of inbreeding on guinea-pigs: SEWALL WRIGHT.

Quantitative relations between chromatin and cytoplasm in the genus Arcella, with their relations to external characters: R. W. HEGNER. (Read by title.)

The Naturalists' dinner was held on the evening of December 28 at the Hotel Emerson with sixty-five in attendance. Following the dinner Professor A. O. Lovejoy led a round table discussion by members of the American Association of University Professors of the work of certain of its committees.

The officers of the society for 1919 are:

President—Edward M. East, Harvard University.

Vice-president—John H. Gerould, Dartmouth College.

Secretary—Bradley M. Davis, University of Pennsylvania (1917–19).

Treasurer—J. Arthur Harris, Carnegie Station for Experimental Evolution (1918–20).

Additional members of the Executive Committee—Maynard M. Metcalf, Oberlin, Ohio (1919); Raymond Pearl, Johns Hopkins University (1917–1919); George H. Shull, Princeton University (1918–20); William E. Castle, Harvard University (1919–21).

Bradley M. Davis,
Secretary

THE AMERICAN FOLK-LORE SOCIETY

The American Folk-Lore Society met in annual session on Friday, December 27, at the Johns Hopkins University. The following papers were read and discussed:

Cape Verde Islands variants of the tale of "the witch and the dogs": Elsie Clews Parsons, New York.

Ceremonies of the Eskimo of St. Lawrence Island: Riley D. Moore, Washington.

The retiring president, C. M. Barbeau, was prevented by illness from attending and delivering the presidential address entitled "The field of European folk-lore in America." The following papers in the absence of the authors were read by title:

Resources of Celtic folk-lore in northeast America: Edward J. O'Brein.

Some French-Canadian folk-songs from Gaspé: Loraine Wyman.

The officers of the society for 1919 are the following:

President—Dr. Elsie Clews Parsons.
First Vice-president—E. C. Hills.
Second Vice-president—J. W. Fewkes.
Permanent Secretary—Charles Peabody.
Treasurer—A. M. Tozzer.
Editor—Franz Boas.

THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

The American Anthropological Association held its sessions on December 27 and 28 at Johns Hopkins University, Baltimore. The Friday morning meeting was devoted to the reading of papers and their discussion as in former years. The following papers were read:

The estimated weight of the parts of the lower extremities in living men: Robert Bennett Bean, University of Virginia.

The relation of towers to prehistoric Pueblos: J. Walter Fewkes, Bureau of American Ethnology.

Indian mounds and other relics of Indian life in Texas: J. E. Pearce, The University of Texas.

In memoriam, Herman K. Haeberlin: Franz Boas, Columbia University.

In addition to these the following were read by title in the absence of the authors:

Ceremonial objects excavated at Otowi, New Mexico: Lucy L. W. Wilson, Philadelphia.

Excavations at Hawikuh, New Mexico, in 1917 and 1918: F. W. Hodge, Museum of the American Indian (Heye Foundation).

Mountain haunts of the coastal Algonquins: Max Schrabisch, Paterson, N. J.

Ethnography of the Jugoslavs: Beatrice Stevenson Stanoyevich, New York.

At the Saturday morning session, papers which had already been published were taken up for discussion. This innovation resulted from the experience of past years, that worth-while discussion of papers, new and just read, was seldom possible.

At the business sessions of the council of the association Professor J. C. Merriam, of the Executive Committee of the National Research Council, presented for discussion a plan for a future permanent research body which should include a division of anthropology. The matter was referred to a committee consisting of Professor Boas, Dr. Hrdlička, and Professor Tozzer, who were directed to present definite research problems of the types most likely to be undertaken and to ascertain the organization best adapted for dealing to advantage with such problems.

The following officers were elected:

President—Clark Wissler, Museum of Natural History, New York.

Vice-president, 1919—John R. Swanton, Bureau of American Ethnology.

Vice-president 1920—George Grant MacCurdy, Yale University.

Vice-president, 1921—A. Hrdlička, U. S. National Museum.

Vice-president, 1922—B. Laufer, Field Museum of Natural History.

Secretary—Alfred M. Tozzer, Harvard University.

Treasurer—Neil M. Judd, U. S. National Museum.

Editor—Pliny E. Goddard, American Museum of Natural History.

Associated Editors—John R. Swanton, Robert H. Lowie.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE PHYSIOGRAPHY OF VERMONT[1]

AT this time no discussion of many interesting though difficult and perplexing questions to which a study of Vermont physiography gives rise will be attempted, but simply a brief consideration of its most conspicuous features.

Geologically Vermont is one of the oldest parts of the country as it contains very little rock that was formed later than the Ordovician. The geological history of Vermont, like that of most regions, may be properly divided into several distinct periods.

The Adirondacks of New York on the west side of Lake Champlain are mostly Pre-Cambrian and at the same time, or probably somewhat later, but still in Pre-Cambrian time, a fold or folds, rose on the east and formed the first elevation of the Green Mountains. Thus the Champlain Valley with its present outline was established in this early period.

Pre-Cambrian rocks have been found in the Green Mountains in only a few localities, but as yet no extended study of these mountains has been made. When thorough investigation shall reveal their complete structure the backbone or axis of the Green Mountains will almost certainly be found to be of an age earlier than the Paleozoic.

At this time then there was the Adirondack ridge on the west and the Green Mountains ridge on the east and between them a strait or channel which connected New York Bay with the St. Lawrence Gulf. An era of erosion and subsidence followed and the great ocean rolled over the whole country east of the Adirondacks.

[1] Address of the vice-president and retiring chairman of Section E, Geology and Geography, American Association for the Advancement of Science, Baltimore, December, 1918.

In these waters were laid down thousands of feet of Cambrian and Ordovician sediments which later became the sandstones, limestones and shales now found along the shores of Lake Champlain and for a few miles eastward.

Not long after the close of the Ordovician, metamorphism occurred and the sedimentary beds became mainly schist, slate and gneiss, although there were also quartzite, conglomerate and silicious limestones where the alteration was less complete. The marbles of Rutland County are the result of a somewhat varied phase of this metamorphism, acting chiefly on Chazy and Trenton beds.

Upheaval, folding, faulting and dike intrusion came at this time, as did also the elevation of the present Green Mountains. The sedimentary beds had been laid down before the final elevation upon the eroded and sunken Pre-Cambrian.

Now came an immense interval when, so far as there is any evidence, practically no rock formation occurred in Vermont. There are slight exceptions. A bit of Devonian on the shores of Lake Memphremagog, a trifle of Silurian on the extreme southern border of the state and a larger, but comparatively insignificant belt of Tertiary with its most important outcrop, the Brandon Lignite, are all before the Pleistocene.

What happened during the incalculable time between the Ordovician and the Pleistocene no one knows, but there is no doubt that during this age-long interval erosion beyond imagining must have taken place, and in many respects the land forms were changed.

As is well known, Vermont is decidedly a mountainous state. There is, to be sure, abundance of level ground and good tillable land, but dominating all are the mountains. In single townships there are thirty or forty peaks of noteworthy size and in some instances more than half of these have never been named. In northern Vermont the Green Mountains are somewhat irregularly scattered, but about fifty miles south of the Canadian border they come together in the single range which continues southwards. By this range Vermont is sharply divided into the eastern Connecticut Valley and the western Champlain Valley.

Any one who journeys through the state finds it easy to pass by good roads from north to south, but from west to east it is often very difficult and in many places impossible. Even politically Vermont has an east and west side, and the very shape of the state is suggested by the presence of this north and south series of mountains.

Naturally, the name of the state recalls only the Green Mountains and certainly the peaks and foothills of this range are by far the most important physical features. On the western border, however, is the not inconsiderable Taconic Range and the series of Sand Rock Hills, while east in the Connecticut Valley are the Granite Hills.

Probably the Taconics were formed somewhat later than the better known Green Mountains. They begin just south of the middle of Vermont and continue, as the Berkshire Hills, into Massachusetts. Though far less important than their larger and more widespread associates, the Taconics are not insignificant. They extend for many miles and include a number of summits over three thousand feet high. Equinox in Manchester is nearly four thousand feet high. In passing through the beautiful valley from Bennington to Rutland the Taconics are conspicuous on the north and the Green Mountains on the south, and the two ranges differ noticeably in outline. The Taconics are largely synclinal in structure, while the Green Mountains are anticlinal or monoclinal. Says Dale in "Taconic Physiography":[2]

> The synclinal mountains must correspond to the original valleys and the anticlinal valleys to the original mountains.

This statement also gives a hint of the great extent to which erosion has taken place in these mountains. This is also shown by the following from the same article:

> As the limestone of the valley underlies the schist these valleys must originally have been covered by schist and therefore about half a mile of

[2] Bulletin 279, U. S. G. S.

schist besides the eroded limestone ought to be restored to the valley (and) where the Cambrian limestone comes to the surface in anticlines, the entire limestone formation as well as the schist ought to be added, *i. e.*, at least 3,500 and possibly 5,000 feet, leaving out the Silurian Grit.

The differences in form are clear when the two ranges of mountains are before one, but they are not easily described. The Green Mountains are characterized by rounded, though not dome-shaped, summits, frequent long ridges radiating from them and occasionally sharp cliffs, but nowhere is there the very rugged, angular, pyramidal outline of the Matterhorn type.

The greater part of the mountain mass consists of gneiss and, of course, the general forms of the various summits are due to the effect of long weathering and glaciation upon this material.

The outlines in the Taconics are even more rounded than are the Green Mountains, the mass is often more elaborately dissected, the ridges more numerous and longer. Beginning in Snake Mountain in Addison, somewhat north of the middle of the state is a series of low mountains and hills, nowhere united in a range, but standing as isolated elevations not far from the shore of Lake Champlain.

Nearly all of these are less than a thousand feet high, though one or two are more, and they are mostly composed of Lower Cambrian red sandstone, but there are occasionally shale and quartzite. Silicious limestone of the same age also occurs in small amount. This series has been known as The Red Sandrock Formation, but as this name is preoccupied and as the terrane as found in western Vermont appears to be sufficiently distinct to deserve a local name, it is suggested that these beds of sandstone with some shale, quartzite and limestone be called the "Winooski Beds."

Among the characteristic fossils are *Olenellus thompsoni, Ptychoparia adamsi, Kutorgina cingulate, Billingsella orientalis, Huenella vermontana.* These place the terrane in the Waucobian of Walcott.

It seems evident that the outcrops in the lowlands and in the elevations—the series of hills—are Cambrian remnants and that before the Ordovician, Cambrian strata some thousands of feet thick covered the western part of Vermont.

What has been called "The Champlain-St. Lawrence Fault" came after the close of the Ordovician running from Canada through western Vermont and on along eastern New York. This broke through the Cambrian and Ordovician, lifted the eastern side hundreds of feet above the western and shoved it over so that now in many places on the shore of Lake Champlain beds of Lower Cambrian rest directly on those of the Utica Shale, which is at the water's edge. These exposures are very impressive as they form cliffs on the shore of the lake.

The fourth series of elevations in Vermont are not very numerous nor massive, but commercially they are of great importance because it is in these Granite Hills that all the granite quarries are situated and Vermont at present leads the world in production of this stone, as it does in marble.

As the Taconics and Cambrian Hills are west of the Green Mountains, so these are on the eastern side—a series of low mountains wholly of granite, usually more or less dome-shaped and not more than a few hundreds of feet high. Millstone Hill in Barre and Robeson Mountain in Woodbury are types of these granite masses. Probably all are laccoliths and as the granite has a structure that indicates slow cooling of intrusive masses held down by heavy pressure, there was originally a considerable thickness of other rock resting upon the upthrust granite.

As Ordovician fossils have been found in the unchanged limestone near the granite, it seems probable that the covering beds were of this age, though there may be some of the Cambrian as well.

The rocks now associated with the granite are metamorphic so that the igneous activity which resulted in the granite thrust did not take place until after the great metamorphism following the Ordovician. It has been thought that it did not occur till the Devonian or even somewhat later.

One other elevation should be mentioned. Mount Ascutney in Windsor is a conspicuous object in the Connecticut Valley as it stands alone twenty miles from any other hill. Of this it must be sufficient to note that its structure is unique among Vermont mountains and unusually complex, as any one who will refer to Dr. R. A. Daly's account in Bulletin 209, U. S. G. S., will find. Dr. Daly says:

> Ascutney owes its existence to a great stock of quartz syenite.

Also

> Mount Ascutney is, like most New England mountains, a residual or erosion, a monadnock overlooking a dissected rolling plateau.

In so mountainous a region as that of Vermont the elevations of all sorts must form the most obvious part of its physiography, but in any other than an arid region where there are mountains there must also be streams and lakes. Everywhere in Vermont the stern, rugged, impressive mountain scenery is softened by the charm of stream and lake. Aside from Champlain and Memphremagog, there are not far from four hundred lakes and ponds in the state. Some are but a fraction of a mile long, others several miles. Most of them are of glacial origin. The streams are innumerable. There are four rivers that empty into Lake Champlain, although they rise in the eastern part of the state and thus do not conform to the general trend of surface features. These, the Missisquoi, Lamoille, Winooski and Otter have found their way across the mountains. They are antecedent streams and therefore old. Other rivers flow into the Connecticut and a few others elsewhere. Nearly all have formed deltas.

Necessarily the general character of Vermont physiography is much modified by the character of the rocks. As one crosses the state from east to west he will find at least a dozen belts or strips of differing rock material. Along the Connecticut River are schist and slate for the most part, while between these and the mountains are schist, limestone, conglomerate quartzite, etc. The common schists are sericite and phyllite.

The age of these beds, some of which extend through the length of the state, some only for a few miles, has been long in doubt, but within the last few years Dr. C. H. Richardson, working on the Vermont Survey, has studied the rocks of eastern Vermont and has been fortunate in discovering in limestone beds at many localities crushed graptolites, some of which have been identified by Dr. Ruedeman as undoubtedly Ordovician.

So numerous and widely distributed are these outcrops that it appears quite certain that eastern Vermont is largely Ordovician, though there may be a small amount of Cambrian. As has been indicated, much of the rock east of the Green Mountains is highly metamorphosed and when the mountains themselves are reached exceedingly complex structure is found. It will probably be a long time before all the intricacies of Green Mountain geology are disentangled.

For a few miles west of the mountains the rocks are similar to those found in the Connecticut Valley east of them. Farther west there are sedimentary rocks which have been somewhat changed, and near the lake others which are unchanged. The shores of Lake Champlain afford many excellent opportunities for studying the Lower Cambrian, and the divisions of the Ordovician from Beekmantown limestone to Utica shale. All headlands on the eastern shore of the lake are of these beds, as are nearly all the islands in Lake Champlain.

The last period in the making of Vermont physiography is, naturally, the Pleistocene. The usual events of this age are too well known to need repetition here and what the Pleistocene was elsewhere it was in Vermont. There is here no evidence that more than one advance of the ice came over the region we are considering. Evidences of the action of the glacier that moved over Vermont are everywhere and if other glaciers preceded it, all traces of their coming have been removed by the last. This seems to be of the time of the late Wisconsin and it covered the highest mountains, as scratches on bits of quartz enclosed in the gneiss show. The gneiss itself is

too much weathered to show glacier scratches.

The oscillations of the land surface in the Vermont region are well known to geologists, as are the effects produced upon the surface by which in various ways both highlands and lowlands were modified. One class of these phenomena is found in the ancient water levels which are plainly discernible in many localities.

Geologists are indebted to Professor H. L. Fairchild for his careful study of these levels through New England. So far as Vermont has been studied, Dr. Fairchild's results are given in the Tenth Report of the Vermont Survey.

Of the level plains, terraces and similar features he writes:

> The broad stretches of sand plains on both sides of the Champlain Valley and conspicuous in Vermont are clear evidence of standing water at levels far above Lake Champlain.

Again:

> The terraces, beaches and shore phenomena in the open Champlain Valley were produced by waters confluent with the sea. The summit marine plane lies uplifted to-day about four hundred feet above tide at the south edge of Vermont and about eight hundred feet at the north border of the state.

Most if not all the terraces in the Connecticut Valley which have been explained as due to river flood action are to be accounted for in the same manner as Professor Fairchild has shown in Bulletin, Geol. Society, Vol. 25, pp. 219–242.

The condition of Lake Champlain and the many changes through which this lake has passed from Pre-Cambrian time to the end of the Pleistocene forms an interesting chapter in the physiographic history of Vermont, but the story is far too long to be told at this time.

From what has been shown it will be seen that the present physiography of Vermont has become what it is through the action of a great variety of geological agencies during several periods of past time.

At least eight epochs may be defined. First, in Pre-Cambrian times were formed the hard crystalline rocks found in the interior of the Green Mountains. Second, an unknown interval of erosion and subsidence, during which a large part of the Pre-Cambrian beds were removed. Third, Cambrian deposition when the sandstone, shale and limestone of this time was laid down. Fourth, a relatively short period of erosion when these beds were all carried off except the few remnants now standing. Fifth, deposition of thick beds of limestone and shale in the Ordovician ocean. Sixth, a period of igneous activity and metamorphism during which the schist, quartzite, gneiss and slate and marble were formed. This was the time of the greater uplift of the Green Mountains as now they appear. Seventh, a vast interval from the close of the Ordovician to the beginning of the Pleistocene. Eighth, the Pleistocene glaciation and erosion.

George H. Perkins
University of Vermont

WHAT KINDS OF BOTANY DOES THE WORLD NEED NOW?[1]

For months, even years, after the great war began I felt that the world had suddenly been plunged into darkness, intense and impenetrable, in which one could only grope one's way, unable to determine or to keep one's direction, shocked and grieved that those lights, which were thought to serve as guides before, had so completely gone out. I believe now that this series of figures is wrong; that, instead, the world has had such a light turned upon it that we are dazzled, if not blinded, that its shams have been exposed as the pleasing envelopes of selfishness—mercenary, political and social—that the lights which had guided us before are still burning but that they have become so shaded and dimmed by human goggles that they disappeared in the flood of light which makes war a great revelation of human weakness, human wickedness, human stupidity, and human ideals.

[1] An address delivered at the meeting of the San Francisco Bay Section, Western Society of Naturalists, at Stanford University, on November 30, 1918.

It may be more the function of others to inspect the quaking edifice of civilization, to ascertain and repair its weaknesses; but now is certainly the opportunity, and hence the obligation, of scientific men to review their sciences, to consider the relations of science, be it zoological, botanical or geological, to human life, human needs and human ideals. This review should comprise both the pursuit of science, research if you will, and also the teaching of science.

So far as the teaching of botany is concerned, two such reviews have come to my notice, one English, the other American.[2] No one, so far as I recall, has recently reviewed the pursuit of botanical science in any more public way than in addresses to professional audiences, such as the botanical section of the American Association for the Advancement of Science, and its affiliated societies, and even these reviews are only relatively recent.

A glance at the botanical science of various epochs in the past shows the changes in emphasis which teachers have given it, changes in direction which its leaders have encouraged. The well-known statement of Mrs. Lincoln,[3] which never fails to release a smile, if not to arouse a laugh, whenever it is quoted, is but one of many statements of the peculiar fitness or of the importance of botanical study for a part or the whole of the human race. But in spite of these statements the world has little idea of what botany really is or what its devotees are trying to accomplish. Hence, while to name a man a plant pathologist is to connect his name with one of the branches of botanical science, to call him a botanist is to suggest to the mind of the average man something very different from the vigorous and virile person capable of working hard a good many more than eight hours a day and playing at least equally hard besides. Why is this? The explanation seems to be that the various branches of botanical science have themselves forgotten their origin, soon after they became independent, and the rest of the world never knew or cared. What "man in the street" is aware that the present science of bacteriology had its foundations laid and its first story built in botanical laboratories, and that even now bacteriological papers come from the same source? Forestry is botanical science applied to trees and the accompanying vegetation of the forest, and no forester is anything more than an administrator, no matter how much engineering, entomology and geology he may know, unless he is first and foremost a botanist, versed in the anatomy and physiology of the trees which he is to sow, cultivate, protect from damage by disease, animals and fire, and to harvest. Horticulturists, agriculturalists, farmers, are botanists as well as the New Englandish spinster who "analyzes" some of the by-products of a summer vacation. By superior organization, admirable enthusiasm, and freedom from that excess of modesty which has been one of the misfortunes of botanists, every one knows of plant pathologists and of plant pathology. But the plant pathologist can not recognize a diseased plant unless he knows what it looks like when it is well, he can not tell what is wrong about its functions unless he knows the normal ones.

All of these men are applying, consciously or unconsciously, what has been learned through the experience of the race and the deliberate investigations of the few. Whenever the fruits of "pure science" can be used, they become applied science or "practical." But nothing can be applied that is not first found out, and the changing requirements of the world make new demands upon the stores of knowledge acquired by study and by experience. The careful housewife draws out from her stores in attic and closet what she has put away as prospectively but not immediately useful, and thereby she saves unnec-

[2] See a series of contributions in numbers 1–6, *New Phytologist*, 17, 1918, and Davis in SCIENCE, N. S., 48, No. 1247, November 22, 1918.

[3] Lincoln, Mrs. Almira H., "Familiar Lectures on Botany," 3d edition, Hartford, 1832, p. 14: "The study of botany seems peculiarly adapted to females; the objects of its investigation are beautiful and delicate; its pursuits, leading to exercise in the open air, are conducive to health and cheerfulness."

essary drain upon the family purse. Thus the accumulations of years come, sooner or later, into use. So it is with science. In these last years of unusual and great stress, the knowledge of woods has brought about the utilization, with the minimum loss of time, of spruce, black walnut and other materials in the manufacture of airplane parts.

No one should be so unimaginative as to wish to check curiosity merely because one may not see now what possible use there may be of the fruits of curiosity. Scientific curiosity should have the heartiest support and encouragement. There should be no neglect of "pure science" merely because the world is hungry; but because the world is hungry, can not we botanists take account of stock and make some estimate of what parts of our field of study are likely to help most to relieve the present need? As a plant physiologist some parts of my subject seem to me to have more immediate prospects of usefulness than others, and to deserve for this reason more study. I can conceive, for example, no reason, scientific or other, for attempting to carry the study of geotropic phenomena any further until the chemist has thrown more light upon the contents and the changes within the cell. But that one should conclude that all study of irritability should stop is absurd. We may, perhaps, well conclude that further study of the directive effects of light may cease for a time, for we know pretty well about the movements, the bendings, of motile and sessile organisms toward or from sources of light: but how much do we actually know about the effects of light upon that chain of processes which ends in the production of fruit and seed? The observations of Delpino, the experiments of Vöchting and Klebs, the experience of agriculturalists and horticulturists in the sunlit arid regions of our western country and in the greenhouse, all point to light as the most effective stimulus to reproduction in plants that we know. Would there be any unworthiness in the student of plant physiology who is interested in the phenomena of irritability choosing to work on the influence of light rather than on the directive influence of gravity?

The most important chemical reaction in all nature, from the standpoint of man and other living things at least, is that which results in the combination of carbon dioxide and water into sugar. The botanist has been fond of saying that plants stand between the animal kingdom and starvation; but what has he done about it? I do not ignore the invaluable studies of plant nutrition which have been carried on and are now in progress; but too many of us have given little thought to the problems involved in that reaction of which the botanist is peculiarly the custodian. Need the world have been as hungry to-day as millions of its inhabitants are, if we botanists had reflected as much upon the processes of nutrition in plants as we have, for example, upon the possible or probable course of evolution? Do we realize that, while water can only be moved, it can not be made, food can be made, and made so near to the points of maximum consumption, that the problems of transport can be very greatly reduced, if the kinds of food and the methods of culture are more accurately adjusted to the demand? This is not merely a problem for the economist; it is a problem of first rate importance for the botanist.

My allusion to the doctrine and the studies of evolution must not be misunderstood; for no one acknowledges more frankly the enormous benefits, material as well as intellectual, which have flowed from the emancipation of the race from the bonds which held it for generations, however deplorable the results of a misguided application of one of Darwin's doctrines may have been in the last four years. But whatever the course of evolution may have been, we know that it is possible, because plants are plastic under cultivation, to breed strains which will withstand, for a time at least, conditions and enemies which others can not endure. Acquired characters may or may not be heritable; but conditions may be so modified that, in the new complex, a new and endurable balance is established.

The indirect fruits of the studies of Mendal and De Vries and their followers are profitable to the race, very profitable, though this was not foreseen probably during the years that monk and professor were working in their gardens on problems of apparently purely theoretical interest. In the light of subsequent events it is easy for us to guess that an intelligent visitor might have appraised these experiments as more likely to be useful at some time to the race than some others which we may imagine him to have seen at about the same period. And we can to-day make just such judgments, leading our students, however elementary, to thoughts no less developing, no less elevating, but more suggestive of possible benefit to themselves and their contemporaries, than others which we may select from our repertoire.

In a meeting which has been filled with interesting and enthusiastic descriptions of work done, a "paper" which contains nothing but reflections may seem the more completely out of place if the question which it asks is not answered in definite terms; but I am so averse to anything which may even seem to dictate what intelligent, thoughtful, conscientious students and teachers should do that, even if I had a formula, I should keep it to myself. My purpose will have been served if, in addition to those who have so far discussed with themselves and others the question before us, we all search for an answer which we can effectively put into action. For the college no less than for business, peace will bring the need of reconstruction; and he who fails to take a long, broad and deep view of the subject of his own greatest interest will fail to share his best with the world which supports him.

George J. Peirce

DAVID ERNEST LANTZ

After an illness of only a week, Professor David E. Lantz, assistant biologist in the Bureau of Biological Survey, died of pneumonia at his home in Washington, D. C., on October 7. He was born at Thompsontown, Pa., March 1, 1855, and his early education was received in the public schools and at the State Normal School at Bloomsburg, Pa., where he graduated with the degree of M.S. In 1878 he removed to Kansas where he became widely known in educational and scientific circles. He served as superintendent of schools at Manhattan, professor of mathematics in the State Agricultural College from 1883 to 1857, principal of the Dickinson County High School, and field agent of the Kansas Agricultural Experiment Station.

In 1904 he received an appointment in the Bureau of Biological Survey as assistant biologist, and since that time has been occupied mainly in investigating mammals of economic importance. He was particularly active in collecting and applying information in regard to the domestication and uses of native mammals, and published papers on deer farming, raising rabbits for food, muskrats and skunks for fur, and guinea pigs for use in laboratory work. His work was especially important in relation to food conservation in developing and applying practical methods of destroying animals injurious to agriculture and stock raising. He spent much time in the field demonstrating methods of preventing the depredations of prairie-dogs, pocket gophers, jack rabbits, ground squirrels and field mice. More recently he devoted his attention with a considerable degree of success to the organization of cooperative campaigns to destroy rats.

Professor Lantz was always active in scientific circles. He served as secretary and president of the Kansas Academy of Sciences, of which he was a life member. He was also an honorary life member of the Kansas State Horticultural Society, an associate member of the American Ornithologists' Union, and a member of the Biological Society of Washington.

While in Kansas, he took a lively interest in its fauna, devoting his spare time largely to collecting specimens and compiling information relating to the vertebrates of that state. He acquired a field and museum knowledge of birds and published a revised edition of Snow's "Birds of Kansas." He also prepared a work-

ing list of Kansas reptiles and batrachians, which, however, have not been printed. In entomology, he was an authority on tiger beetles (Cicindelidæ) having brought together an excellent collection of them during his travels in various parts of the United States from the Rocky Mountains eastward.

A voracious and consistent reader along his special lines, he compiled from world-wide sources, during his fourteen years of service with the Biological Survey, a vast amount of information, now carded in his own handwriting in the files of the bureau, supplementary to the results of his experimental work. He wrote as freely as he read, setting forth facts on the printed page in a clear, graceful and interesting style. His numerous papers on economic zoology are well known to farmers and agricultural students in every state in the Union.

The personality of Professor Lantz was kindly and endearing. In field and office alike his gentle humor, patience and industry were an inspiration to his associates, to whom he was ever a cheerful friend and valued counsellor.

NED DEARBORN

PROFESSOR LUDVIG SYLOW

THE Nestor of Norwegian mathematicians, Professor Ludvig Sylow, of Christiania, died on September 7, 1918, at the age of eighty-five years. He was known to the mathematicians of every civilized country on account of a well-known theorem which bears his name. In 1876 Frobenius remarked that "as every educated person knows the Pythagorean theorem so does every mathematician speak of Abel's theorem and of Sylow's theorem."

In view of the general interest in the retirement of university professors at sixty-five it may be worth noting that Sylow was appointed professor of mathematics in the University of Chritiania after reaching the age of sixty-five years. While various other noted European mathematicians were called to university positions after they had spent years in teaching in secondary institutions, Sylow was perhaps the only one among them who devoted forty years to teaching in a secondary institution before securing a university chair.

Notwithstanding the advanced age at which Sylow entered the university faculty he is said to have filled the position during twenty years with marked success. The duties of his professorship did not seem to be burdensome to him until the last year of his life when he frequently remarked that he felt tired.

In 1883 he was elected a member of the Academy of Sciences of Göttingen and in 1894 he received an honorary doctor's degree from the University of Copenhagen. His writings related mostly to the theory of substitution groups and to the works of his great countrymen Abel and Lie. He wrote, however, also on the theory of equations and on the complex multiplication of elliptic functions.

G. A. MILLER

SCIENTIFIC EVENTS

THE BRITISH GLASSWARE INDUSTRY

AN article in *Nature* states that the British Chemical Ware Manufacturers' Association, the British Flint Glass Manufacturers' Association, the British Lamp-blown Scientific Glassware Manufacturers' Association and the British Laboratory Ware Association—organizations representing the manufacture and distribution of scientific glassware—have jointly addressed the Inter-Departmental Glass Trades Committee, representing the Board of Trade and the Department of Optical Munitions and Glassware Supply (Ministry of Munitions), setting forth their views as to steps which should be taken to secure the permanent establishment of the trade in Great Britain. They point out that in 1914 the shortage of scientific glassware threatened disaster. Industries such as agriculture, food production of all kinds and the manufacture of armaments, iron and steel, non-ferrous metals, gas, dyes, explosives, leather and oil, also the military and civil medical services and the public services responsible for public health and hygiene, which could not be conducted without efficient scientific control, were in danger. The "master key" to the

maintenance of our position, and to ultimate victory, was for the moment in the hands of our enemies."

During the war the energy and enterprise of manufacturers have enabled them to build up the industry and to supply all the requirements of the country, but having always before them the immediate needs of the country rather than the future of the industry, the position in which they now find themselves is highly unfavorable compared with that of manufacturers in enemy and neutral countries. Since the outbreak of the war the cost of materials has risen threefold and wages have doubled. The cost of experimental work, the payment of excess profits duty and the heavy charges on capital account have made it impossible to accumulate the funds necessary for the proper financing of the industry; and even so far as money has been available, there has been great difficulty in procuring material for the construction of buildings and furnaces suitable in quantity and quality. The labor difficulty and the calling up of all lads of eighteen years of age have seriously hampered the industry.

In view of the importance of the industry, the associations petition the government to prohibit the importation of scientific glassware into the country, subject not only to licenses being granted in the case of articles not manufactured in the country, but also to the control of prices, and later to impose a duty upon imported goods. They also direct attention to the need for financial assistance, and for aid in carrying out those scientific and technical investigations which are essential if the industry is to be established permanently in the country.

THE STUDY OF INDUSTRIAL FATIGUE

WE learn from the *British Medical Journal* that the Industrial Fatigue Research Board has now been completed. The work was begun by the Health of Munition Workers Committee of the Ministry of Munitions, upon which Dr. Leonard Hill and Sir Walter Fletcher served from the time of its appointment in 1915. That committee was dissolved at the beginning of 1918, and issued its final report last May. But the excellence of its work led to the expression of a wish that arrangements should be made for maintaining on a permanent footing an organization for the systematic investigation of the natural laws of industrial fatigue. Their study, though primarily physiological, offers a field of inquiry in which a knowledge both of medicine and the industrial sciences are necessary for full success. The department of Scientific and Industrial Research, and the Medical Research Committee accordingly determined to establish a permanent organization, and to contribute the necessary financial aid in due proportion. The proposal was warmly approved by the home office, which expressed a desire for the immediate establishment of a research organization of the kind indicated. An Industrial Fatigue Research Board was therefore established a short time ago and has now been completed. It will continue the organizing functions of the two bodies and the investigations already in progress. The Board is instructed "to consider and investigate the relations of hours of labor and of other conditions of employment, including methds of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers." The duty of the board will be to initiate, organize and promote by research, grants, or otherwise, investigations in different industries, with a view to finding the most favorable hours of labor, spells of work, rest pauses, and other conditions applicable to the various processes according to the nature of the work and its demands on the worker. For these investigations the board looks forward to receiving the help of employers and workmen in the industries which are studied, and in appropriate cases representatives of both will be invited to serve as temporary members of the board. The chairman of the board is Dr. C. S. Sherrington, F.R.S., professor of physiology in the University of Oxford, and the members are Dr. E. L. Collis (Director of Welfare and Health, Ministry of Munitions),

Sir Walter Fletcher, M.D., F.R.S. (secretary, Medical Research Committee), Mr. W. L. Hichens (chairman of Messrs. Cammell, Laird and Co., Ltd.), Mr. Edward Hopkinson, D.Sc. (director of Messrs, Mather and Platt, Manchester), Mr. Kenneth Lee (director of Messrs. Tootal, Broadhurst Lee Co., Ltd.), Dr. T. M. Legge, C.B.E. (H.M. Medical Inspector of Factories), Colonel C. S. Myers, M.D., F.R.S. (director of the Psychological Laboratory, Cambridge), Mr. R. R. Bannatyne (assessor representing the home office). The secretary is Mr. D. R. Wilson, H.M. Inspector of Factories to whom at 15, Great George Street, Westminster, S.W.1, suggestions as to any problems needing investigation should be addressed.

STATE PARKS FOR IOWA

AT the last General Assembly of the State of Iowa, a law was passed creating a State Board of Conservation for the purpose of setting aside certain areas in the state for recreation, scientific, historic and forestry purposes. The sum of $50,000 out of the fund coming from hunters' licenses to be set aside for the purchase of such places. The Conservation Board is to report its findings to the Executive Council of the state. Governor W. L. Harding appointed as such a board, L. H. Pammel, of Ames; Joseph Kelso, of Bellevue, and John Ford, of Fort Dodge. Mr. E. R. Harlan, curator of the State Historical Department, is designated in the law as a member of the board. The board recommended the purchase of a region known as the Devil's Back Bone in Delaware County along the Maquoketa River. The area embraces something over 1,200 acres. Some of the original white pines are still standing, as well as a number of the larger oaks and cedars. The wild animal life also is of interest. It is of interest to geologists because of the rough topography, the limestone and the glacial action in the region. This region is also of particular interest from an ecological standpoint.

The board designated that this park and similar parks be known as memorial state parks. The Executive Council adopted the recommendation of the board with reference to the purchase of the Devil's Back Bone and made arrangements to purchase the area. The commission also made recommendation for southeastern and southwestern Iowa, particularly with reference to wooded tracts and some Indian mounds, as well as the Missouri loess area in southwestern Iowa. The board believes history and science will best be served by making few improvements in these parks.

THE PLANS OF THE ROCKEFELLER FOUNDATION

EXTENSIVE work in public health and medical education and the completion of its war work will be the program of the Rockefeller Foundation for 1919, according to a statement issued by the president, Dr. George E. Vincent.

The estimated income for 1919 is $6,750,000. Against this the budget provides $2,264,130 for public health and $3,662,504 for medical education. The other items of the budget are $103,000 for miscellaneous payments on long-term appropriations and $146,662 for administration. The amount still available for appropriations is $465,110. Of the income of 1918 $2,787,406 has been brought forward to meet appropriations for war work made in 1918, but yet to be paid.

The public health activities for the year will be directed chiefly against yellow fever, tuberculosis in France, malaria and the hookworm disease. The Yellow Fever Commission, headed by General William C. Gorgas, in starting a war on the disease which it is hoped will result in its complete elimination. The Commission on Tuberculosis in France will continue its work on an enlarged budget at the request of the French authorities. The campaign against the hookworm will be waged in twelve states here and twenty-one foreign states and countries.

Appropriations have been made for special studies and demonstrations in mental hygiene, for a school of hygiene and public health at Johns Hopkins, and for the development of public health nursing. The chief work in medical education will be the development of training in modern medicine in China through the China Medical Board.

Expenditures for the foundation's war work in 1919 will be for the war demonstration hospital, for work of the medical division of the National Research Council, for assistance in care and treatment of soldiers mentally and nervously disabled, for payment on pledges made in 1918 to the United War Work Fund and for work under the direction of the commissions on Training Camp Activities.

SCIENTIFIC NOTES AND NEWS

Dr. J. A. L. Waddell, head of the firm of Waddell & Son, consulting engineers of Kansas City, Missouri, has been elected a corresponding member of the Paris Academy of Sciences.

The National Geographic Society, on January 10, awarded the Hubbard Gold Medal to Vihjalmur Stefansson, whose explorations during the last five and a half years in the Arctic regions have resulted in the reduction of the unknown Polar regions of the western hemisphere by approximately 100,000 square miles. Admiral Peary introduced Mr. Stefansson at his afternoon lecture, and General Greely presided when the medal was conferred.

Dr. Aleš Hrdlička, curator of the division of physical anthropology at the U. S. National Museum and editor of the *American Journal of Physical Anthropology*, has been elected an honorary fellow of the Royal Anthropological Institute of Great Britain and Ireland.

Trustees of the Massachusetts Agricultural College gave a dinner, on January 14, to Professor William P. Brooks, who has resigned after thirty years' service in the faculty. The United States Department of Agriculture was represented by Dr. E. W. Allen, who paid a high tribute to Professor Brooks's work in the experiment station. Wilfred Wheeler, secretary of the State Board of Agriculture; Dr. H. E. Stockbridge, editor of the *Southern Ruralist*, and representatives of the faculty and trustees, attended the dinner.

At its meeting held January 8, the Rumford Committee of the American Academy of Arts and Sciences voted the following appropriations: To Professor H. M. Randall, of the University of Michigan, for his research on the infra-red spectrum (additional to former appropriation), $200; to Professor Alpheus W. Smith, of the University of Ohio, for his research on the Hall effect in rare metals (addition to a previous appropriation), $100; to Professor A. G. Webster, of Clark University, in aid of his researches on pyrodynamics and practical interior ballistics, $500; to Professor Julius Stieglitz, of the University of Chicago, in aid of the publication of Marie's Tables of Constants for 1919 (in addition to previous appropriations for earlier years), $250.

Professor Frederic S. Lee has returned to his work at Columbia University after a ten weeks visit to England and France as the representative of the U. S. Public Health Service in an investigation of the physiological and hygienic aspects of industrial efficiency. He was able to meet many of the representative men of both countries who are engaged in the study and improvement of industrial conditions. While in England he sat as a member of the Industrial Fatigue Research Board, and he gave evidence before the War Cabinet Committee on Women in Industry.

We learn from *Nature* that Clifford C. Patterson has resigned his position in the physics department of the British National Physical Laboratory, and has joined the General Electric Co., as director of research laboratories.

The honorary degree of D.Sc. has been conferred by the University of Oxford on Mr. William Crooke, known for his researches on the anthropology of the native races of India.

The University of Cambridge has conferred its titular degree of M.A., *honoris causa,* on Mr. Frederic William Harmer, of Norwich, in recognition of his researches in geology.

Mr. James Inglis, Detroit, Mich., chairman, Mr. B. C. Butler, chief of the Bureau of Foreign and Domestic Commerce, Mr. Samuel L. Rogers, director of the Census, Department of Commerce, Mr. E. D. Walen, associate physicist, Textile Division, Bureau of

Standards, Department of Commerce, and Dr. Arthur A. Hamerschlag, president of Carnegie Institute of Technology at Pittsburgh, have been appointed by the secretary of commerce, Hon. William C. Redfield, a committee of five to represent the Department of Commerce in connection with the formation of and arrangement for an international cotton conference. This body is to be formed to discuss subjects of international interest relative to the cotton trade throughout the world.

PROFESSOR F. O. GROVER, head of the department of botany of Oberlin College, has been granted leave of absence for special study in the University of Chicago.

DR. JAS. A. NELSON has resigned his position as expert in the Bureau of Entomology at Washington, D. C., and will make his home near Mount Vernon, Ohio, where he will give his attention to farming. He will remain in connection with the Bureau of Entomology as collaborator.

DR. D. R. HARPER resigned at the close of the year from his position as physicist in the National Bureau of Standards with which he had been associated for ten years as a physicist in the field of thermodynamics. With the entrance of the United States into the war, this work was laid aside as not being of special military importance, and Dr. Harper left the laboratory for administrative work to assist Director Stratton in finding the hundreds of scientific men needed by the bureau. Dr. Harper will continue his work as a personnel and employment expert and has accepted a call to the United States Bureau of Efficiency.

THE eleventh annual conference of Veterinarians was held at Cornell University Veterinary College on January 16 and 17. About two hundred veterinarians from all parts of the state were in attendance. Among those on the program were H. B. Leonard, of the Bureau of Animal Industry; J. G. Wills, chief veterinarian of New York State; Charles S. Wilson, state commissioner of agriculture; John W. Adams, of the University of Pennsylvania; Captain F. C. Waite and Lieutenant Colonel R. J. Stanclift, of the Surgeon General's Office, U. S. A. President Schurman made the address of welcome.

DR. DAVID EUGENE SMITH, of Teachers College, Columbia University, will address the Association of Teachers of Secondary Mathematics of North Carolina in Greensboro, N. C., February 7 and 8. The Association meets this year under the auspices of the State Normal College. On February 6, Dr. Smith will address the students of mathematics of the University of North Carolina.

THE third lecture of the series of the Harvey Society will be given by Major R. M. Yerkes, on "Psychological Examination of the soldier," New York Academy of Medicine, on Saturday evening, January 25, at 8:30 P.M.

HORACE FLETCHER, known as an expert on dietetics, died at Copenhagen, on January 13, from bronchitis after a long illness.

EDWARD A. INGHAM, district health officer of the California Board of Health, a graduate of Massachusetts Institute of Technology and a former instructor there, has died in California from influenza, contracted while combating the epidemic.

THE deaths are announced of Dr. Carlos Barajas, a prominent physician in Mexico City and professor of anatomy in the university, and of Dr. R. S. Gomez, professor of internal pathology and descriptive anatomy at the University of Buenos Aires.

THE committee on scientific research appointed by the trustees of the American Medical Association will consider applications for grants of money to aid in medical research. Applications, which should explain fully the conditions and reasons that appear to warrant requests for aid, may be addressed to Committee on Scientific Research, 535 North Dearborn Street, Chicago, Ill.

SUBSCRIPTIONS have been collected and Senator Borletti has donated a handsome villa with extensive grounds near Milan for an institute to care for the cases of nervous disease which need special and continuous attendance. The president of the association having the matter in charge is Professor C. Golgi, who is also

senator, with Professor E. Medea as the medical chief of the new institution.

According to statistics approximately estimated, the epidemic of influenza in Mexico caused 432,000 deaths.

An application for a license to publish an enemy book on the treatment of shell shock came recently before the Controller of Patents of Great Britain, in the Patents Court. The applicants were Messrs. E. and S. Livingston, publishers, of Edinburgh, who desired to issue volume three of the work of Professor Kraepelin on "Psychiatry," dealing with the treatment of shell shock and of similar disturbances of the mind. The literature on the subject was not extensive, it was said, and this book would be of value in our hospitals. Dr. Kraepelin was a great authority on mental diseases. The editor of the proposed new volume was Dr. G. Robertson, medical superintendent of the Morningside Asylum at Edinburgh for the treatment of mental diseases. The controller said that the volume was clearly of value, and he would report favorably on the application.

It is reported in *Nature* that the question of the payment for the services of scientific men working in connection with the industrial research associations being formed on the lines suggested by the Department of Scientific and Industrial Research has been raised in the House of Commons by Sir William Beale. Though the associations could make remuneration to scientific men appointed to serve on advisory committees, or to specific posts constituted by them, they were not authorized to pay them for services as members of councils or boards of management. It has now been decided by the Board of Trade that this condition may be abrogated, and payment can be made after approval by the Department of Scientific and Industrial Research. Sir William Beale's question, asked on July 18, and Sir Albert Stanley's answer, are as follows:—*Sir William Beale:* To ask the president of the Board of Trade whether he is aware of the conditions under which scientific men are asked to serve on the councils or boards of management of industrial research associations formed under the direction or with the approval of the Board to carry out or promote scientific and industrial research, in consequence of the rules and practise prescribed by the Board of Trade to discourage payment for such services rendered by scientific men other than reimbursement for out-of-pocket expenses; and whether the Board has taken or will take steps to enable such further reasonable remuneration to be paid as will attract to or at least make possible for such research committees as are being formed in connection with the Department of Scientific and Industrial Research the cooperation, advice and assistance of scientific men of undoubted capacity to render valuable services whose position and means do not enable them to do so on mere compensation for out-of-pocket expenses. *Sir Albert Stanley:* In dealing with applications for licences under the provisions of section 20 of the Companies Consolidation Act, 1908, due provision is made for the payment of reasonable remuneration to members of the council of management of such industrial research associations with the approval of the Department of Scientific and Industrial Research.

H. Vincent and G. Stodel have described to the Académie des Sciences, on July 16, a serum for gas gangrene prepared from the horse by injecting the chief varieties of anaerobic microbes which cause the disease. The *British Medical Journal* states that they produced gas gangrene in 89 guinea-pigs by inoculation of the *Bacillus perfringens* into the thigh muscles, followed by crushing by pincers these muscles in the anesthetized animals; after this double action of the bacillus and the trauma gas gangrene usually appeared in about eighteen hours. The mortality of the unprotected animals was seventy-nine per cent., of the protected only four and one half per cent. The serum was used in fifty soldiers with severe badly infected wounds of thighs or buttocks; all remained free from gas gangrene. It was used in thirteen cases of more or less advanced gas gangrene, four of which were regarded by the surgeons as hopeless; twelve recovered. The local and general symptoms usually showed rapid amelioration,

sometimes within a few hours of the inoculation of the serum.

THE 1918 Directory of the American Chemical Society is now available for members. It contains 422 pages as compared with the 1916 directory's 289 pages, and it exceeds by approximately 4,000 the number of members listed in the 1916 issue. The directors have voted that it may be obtained by members from the secretary on payment of $1.00 to cover partial cost of printing and upon their written statement that it is desired for their personal use only and will not be loaned or disposed of to any firm which they may or may not be connected or to any individual to be used for advertising purposes.

A COMMITTEE of the Scottish Geographical Society has been appointed for the formation of a complete collection of the old maps of Scotland, including all early atlases, county maps, charts, town plans and estate plans, and especially manuscript maps. The present acting members of the committee are the Hon. Lord Guthrie, president of the society; Professor P. Hume Brown, LL.D., historiographer royal; J. G. Bartholomew, cartographer to the King; W. B. Blaikie, LL.D., and Harry R. G. Inglis, members of the Council. Mr. Inglis has been appointed honorable custodian of the collection. To this committee the council has handed over the care of all early maps already in the possession of of the society. The committee has acquired by purchase the collection of old Scottish maps belonging to the late Mr. C. G. Cash, who for many years made a special study of the subject; and through the generosity of certain donors and certain fortuitous circumstances, have been placed in such a position that they require only about half-a-dozen general maps to make the collection complete down to 1820, and they already have maps which do not appear in any of the public libraries of Scotland. The collection as it stands is unique, being more nearly complete that any yet gathered. So far, the expenses of the committee have been met by voluntary subscriptions, the amount of which on September 30, 1918, was £111.

UNIVERSITY AND EDUCATIONAL NEWS

THE new mining and engineering building of the University of Arizona, which has been under construction since May, 1917, was opened on January 3. This building is the finest on the university campus and has been constructed and equipped at a total cost of $210,000.

THE faculty of the school of medicine of Western Reserve University has voted to admit women next year.

FOR the first time in the history of the University of Pennsylvania, the doors of the university hospital are to be thrown open to women physicians, who will act as interns. Two women students in the medical department of the university who will graduate in June have been chosen by the managers of the hospital. They will assume their duties shortly after graduation.

PROFESSOR HAL W. MOSELEY has been promoted to be associate professor of chemistry in the Tulane University of Louisiana.

DISCUSSION AND CORRESPONDENCE

EUCALYPTUS NEVER PRESENT IN NORTH AMERICA

THE identification of the antipodean genus *Eucalyptus* in the fossil floras of Europe was the subject for a sweeping condemnation by the veteran systematist Bentham in one of his addresses. Without subscribing to the viewpoint of one who was at best a narrow specialist and could see nothing useful in the study of fossil plants, it remains true that the identification of *Eucalyptus* in many fossil floras has led to what I believe to be erroneous conclusions in the minds of many geologists and botanists who lack both time and the special knowledge for passing on the returns.

A few years ago I advanced a theory of origin and distribution for the family Myrtaceae which was based largely upon the recent and fossil distribution of the different tribes.[1] This theory in its broader outlines considered

[1] Berry, E. W., "The Origin and Distribution of the Family Myrtaceæ," *Bot. Gaz.*, Vol. 59, pp. 484–490, 1915.

America[1] as the center of radiation for the family and regarded the subfamily Myrtoideæ as the most ancient. The subfamily Leptospermoideæ was regarded as derived from the former; and the Australian types, which are the peculiar ones of the family, were regarded as having originated in that region in response to local environmental conditions subsequent to the Cretaceous radiation of the family stock. Genera such as *Eugenia* and *Myrcia* were regarded as representing this ancestral stock more nearly than any other of the existing genera.

This theory considered *Eucalyptus* as one of the more specialized genera and is this conclusion I agreed entirely with Andrews and other Australian friends who have repeatedly expressed doubt regarding the presence of *Eucalyptus* in the fossil floras of the northern hemisphere. Without wishing to be dogmatic about European fossil forms referred to *Eucalyptus* and known to me only from figures, I may say that I do not regard the genus as ever having been present in North American, although in conformity with long-established custom and with due consideration for the stratigraphic applications, I have frequently referred fossil forms to this genus.

A question of considerable importance is the real botanical affinity of the numerous North American Cretaceous forms which have been referred to *Eucalyptus*. These are undoubtedly ancestral to the American Eocene forms referred to *Eugenia* and *Myrcia*, and it would probably not be far from the truth if they were referred to the genus *Myrcia*. I have collected and studied a great many of these Cretaceous types and some of them are certainly closely allied to, if not identical with that genus. Others are somewhat remote and pending a solution of their botanical affinity, which may never be satisfactorily attained, I would advocate the dropping altogether of the use of *Eucalyptus* for those North American fossil forms. This usage is seriously misleading from the standpoint of evolution and distribution, and moreover is not supported by any valid botanical arguments, as I pointed out in the paper already alluded to at the beginning of this note. The alternative that I suggest is the taking up of the genus *Myrtophyllum* proposed by Heer in 1869[2] and using it for leaves of Myrtaceæ whose generic relations can not be determined with certainty, and more especially for the leaves commonly referred to the genus *Eucalyptus*.

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THE RICHARDTON METEORITE

On July 21, about 10 P.M., many people saw a meteorite fall in the district lying between Mott and Richardton, N. D. From the descriptions of many eye witnesses it appears that the meteorite fell at a low angle, about 75° from vertical, and that its direction of flight was about due north. It seems to have burst a few thousand feet above the ground, and to have broken into many pieces, over a hundred of which have been found. The weight of the material discovered is about 200 pounds. The meteorite is stony, poor in metallic parts, composed of little spheroids in a gray brittle matrix, classified tentatively by the writer as a veined kügelchen chondrite.

Nearly all the witnesses agree that the meteorite made a very bright light and a rushing sound, followed by a noise like thunder, and that it made the windows rattle and the houses shake; two men heard the whistle of stones like the flight of bullets, and one heard the stones rattle upon the roof of his barn, near which specimens were later found. The most intelligent witness says it looked first like a very bright falling star, and that it burst like a Roman candle, after which he heard the stones falling. Every one admits that he was very much frightened, most of them emphasize the terrifying noise and the brilliant light.

The meteorite did not fall at a very high velocity, for few pieces have been found buried in the ground, most pieces were found in pastures or wheat fields. Two pieces at

[2] Heer, O., *Neue Denks. Schw. Gesell. Naturw.*, Bd. 23, mem. 2, p. 22, 1869. Type being the widespread mid-Cretaceous species *Eucalyptus Geinitzi*.

least were found partly buried in loose soil. One, weighing 6¾ pounds, was found about six inches in sandy soil where it had fallen and broken into several pieces as it struck. Some pieces show secondary fusion surfaces, and some appear to show tertiary fusion surfaces. The stone is brittle and most of the pieces are broken; however, one fine boloid of twenty pounds has been found and several of about ten pounds weight.

The writer is preparing a detailed description of the meteorite and the phenomena of its fall and would appreciate any data that may have been gathered by other observers or collectors.

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SCIENTIFIC BOOKS

Catalogue of Birds of the Americas. By CHARLES B. CORY. Part II. No. 1. Publication 197, Field Museum of Natural History; Zoological Series, Vol. XIII. March, 1918. Pp. 1–315; pl. I.

This catalogue intends to treat all the species and subspecies of birds known to occur in North America, Middle America, West Indies, and South America, including all the adjacent islands of the Atlantic and Pacific oceans. Although the present installment is first in the order of publication, it is called Part II, No. 1, since it begins with the owls instead of with the lowest forms. This seems rather unfortunate, but the author explains it on the ground that Mr. Robert Ridgway's great work on the birds of North and Middle America is not yet finished as far as the lower groups; and that more time than is now available will be necessary in order to work out the status of many of the water birds of South America.

The classification adopted for this catalogue is practically that of Dr. R. B. Sharpe, as used in his "Hand-List of the Genera and Species of Birds." The outline of this classification down to families, in so far as it affects the birds of the Americas, is included in the introductory matter. The present part comprises 1,265 species and subspecies, representing 232 genera of the following families: Bubonidæ, Tytonidæ, Psittacidæ, Steatornithidæ, Alcedinidæ, Todidæ, Momotidæ, Nyctibiidæ, Caprimulgidæ, "Cypselidæ" (*lege* Micropodidæ) and Trochilidæ.

Of the higher groups nothing but the names is given, but for each genus there are added the authority, the original reference, and a citation of the type. For each species and subspecies there appear the full technical combination; the common name; reference to the original description; the type locality; such essential synonymy as references (usually not over half a dozen) to Mr. Ridgway's "Birds of North and Middle America," "The Catalogue of Birds of the British Museum," original descriptions, revisions of groups, and other important papers; a brief statement of geographic range; and a list of specimens (with state or country localities) contained in the Field Museum of Natural History. An asterisk (*) indicates species represented in this collection, and a dagger (†) those of which there are specimens for exchange.

For all species and subspecies not included in Ridgway's "Birds of North and Middle America" or "The Catalogue of the Birds in the British Museum," brief descriptions are added in footnotes, along with various comments on nomenclature and the status of forms. The following subspecies are described as new: *Speotyto cunicularia minor,* from Boa Vista, Rio Branco, Brazil; *Aratinga cactorum perpallida,* from Jua, near Iguatu, Brazil; *Eupsittula pertinax margaritensis,* from Margarita Island, Venezuela; *Amazona amazonica tobagensis,* from Tobago Island, West Indies; *Urospatha martii olivacea,* from Moyobamba, Peru; *Nephœcetes niger guadeloupensis,* from Guadeloupe Island, West Indies; *Lepidopyga goudoti zuliae,* from Rio Aurare, Venezuela; and *Colibri iolatus brevipennis,* from Caracas, Venezuela.

We are glad to see that in headings the full technical name of each species and subspecies is written without abbreviation; also that the

oldest tenable names and the original spelling of generic, specific and subspecific terms are used, including those formed with the termination *ii* from the names of persons. We note, however, an occasional slip, as, for example, *Phæthornis guyi,* which should be written *Phæthornis guy,* to agree with the author's practise in the case of *Chætocercus heliodor.*

Recent ornithological work concerning the birds of America has been carefully collated, and the present catologue appears to be brought well up to date. It is doubtless worth while to note that since a number of the families included are peculiar to America, the present catalogue presents a complete list of the genera, species, and subspecies of Steatornithidæ, Todidæ, Momotidæ, Nyctibiidæ, and, most important of all, Trochilidæ.

There is only one illustration, the frontispiece in color, which depicts *Urochroma costaricensis* Cory. There is no index, but this is probably to be supplied at the end of Part II.

This work is unfortunately marred by many typographical errors in both scientific and common names. We are also sorry to see the the perpetuation of the vernacular name "nighthawk" for the species of the genera *Nyctiphrynus, Antiurus, Setopagis,* and *Nyctipolus,* for these do not belong to the same family as the true nighthawks (Chordeilidæ), but to the Caprimulgidæ, and are nearly related to the whip-poor-wills. Furthermore, there does not seem to be a satisfactory reason for continuing the use of *Antrostomus* instead of *Setochalcis* for the American whip-poorwills, since there are many excellent characters, external as well as osteological, to separate them from *Antrostomus carolinensis.* Also, the American barn owls are clearly subspecies of the European *Tyto alba,* not of the South American *Tyto perlata.*

This catalogue is the first serious attempt at an enumeration of the birds of all America, and is so well done that it can not fail to have before it a long career of great usefulness.

Harry C. Oberholser

SPECIAL ARTICLES

PSYCHOLOGICAL RESEARCH IN AVIATION[1]

With the exception noted below, official research on psychological problems of aviation was conducted under the direction of the Medical Research Board, a branch of the Air Medical Service which (the A. M. S.) took charge of the medical, physiological and psychological problems concerning the behavior of the fliers. I began work at the Bureau of Mines Laboratory in October, 1917, with two assistants, and continued in charge of the Psychological Department until August 30, 1918, on which date I was removed from the Mineola Laboratory. During this period the psychological staff grew to (approximately) twenty-five officers and seventeen men (counting several who were commissioned shortly after my leaving, on my previous recommendations). The response of the members of the psychological profession to my calls for assistance was most liberal, and although we did not have a staff large enough to do effective work it was on account of the difficulty in securing commissions, not on account of lack of competent psychologists willing to make the sacrifice.

Work on tests of flying ability was commenced earlier, outside the Medical Board, by Professor Stratton, at first independently, and later under the Air Personnel. Upon my urgent recommendation, the board succeeded in having Professor (now Major) Stratton transferred to the Mineola Laboratory, bringing all the psychological research under medical control, and on my removal Major Stratton was placed in charge of the department.

The first work required of the board was the construction and standardization of a test for determining, if possible, the individual flier's ability to endure the partial asphyxia-

[1] A paper read before the Baltimore meeting of the American Psychological Association in joint session with Section H, American Association for the Advancement of Science, December 28, 1918. Authority to publish, with deletions, granted by Board of Publication, S. G. O.

Asterisks in the text indicate deletions.

tion incident to high altitudes. I entered this work with the understanding that as soon as such a test was completed I should have opportunity to investigate other (and in my opinion) more important psycho-physical problems. (I should not want it to be supposed that I was willing to disorganize my university work for the development of such a test merely.)

A summary of the work in the development of the psychological part of the "rating test" has been published (by order of the board) in the *Journal of the American Medical Association*. More detailed account of the experimental work involved in the perfecting of this test will be given later (I hope) in a technical journal (probably in *Psychobiology*). There is not time, of course to elaborate the details here. I may point out that we embarked on an unknown sea, and that we were able to get results in a relatively short time must be ascribed to the small but highly efficient staff I assembled in the early months of the work. After trying a wide range of standard psychophysical tests, and some we devised ourselves after usual patterns, with puzzling results, we hit upon the actual primary effects of asphyxia, and were then able to devise tests to fit.

These primary effects, we found, are not on any special mechanism or division of the nervous system (I except of course the cardiovascular and respiratory mechanisms), but are upon the *integration* of the system, and are evidenced in the decrease in sensory-motor coordination, and in range and sustention of attention. The so-called "higher mental processes" are affected in so far as they depend on attention and coordination, and no further. For example, a man may be able to make accurate observations visually, up to the time he can no longer "keep his attention on the task" (that is, if diplopia does not interfere), and record them, until his records become undecipherable, and also be able to remember these observations with normal accuracy. These findings I consider of great importance for future psychological work.

The functioning of "attention peaks," as we have called brief spurts of normal attention and coordination, is one of the important practical findings. Even with large actual deterioration of the patient's mental ability, he is able to bring himself back to his usual level of efficiency for a brief period, if given the appropriate mental stimulus. In this way, ordinary methods of testing, entirely fail to show the patient's real condition. In my own case, for example, I become diplopic regularly in the early light stages of asphyxiation, but the usual oculist's test shows no diplopia until the asphyxia has reached a much more serious stage, because the presentation of the test object "pulls me together," and for the few seconds required I coordinate properly, relapsing into diplopia as soon as the test is over. The importance of these attention peaks in working on fatigue, bad ventilation, and drug effects, is too obvious to need further emphasis.

The work of the psychologists, as will be readily imagined, was necessarily extended over a wider scope than the devising of the fundamental psychological part of the "rating test." Such disagreeable tasks as securing a system of work under which visitors were excluded from the room where the patients were being tested, protecting the patient from distraction and excitement by careless remarks of those belonging to the combined medico-physio-ophtho-psychological group of examiners, and similar routine precautions against invalidating work, the psychologists were of course forced to assume. This produced friction at first, as many of the men beginning the testing work were unaccustomed to research work, but they soon grasped the situation, and excellent cooperation was secured with the men in the other departments engaged upon these tests.

Into the discussion of the test as a whole there is not time to enter far. As applied in the field, men were rated chiefly on the psychological findings, the cardiovascular, respiration and ophthalmological findings figuring in minor degree. Although the blood-pressure observations were introduced by the psychologists, and carried on by us until the physiologists were convinced of their value, we were

in no wise responsible for their use as a factor in rating, having introduced the observations simply as a protection to the patient, and for the securing of experimental data.

Owing to the necessity of hurrying the test to application as soon as it was standardized, we were not able to carry on investigations to determine the ultimate significance of the test.

Sets of experiments were several times started in cooperation with the physiological department, to determine the significance, but the need of the officers carrying them on for field work in applying the test necessitated their discontinuance. It is certain that the test gives a relative measure of the individuals' ability at the time tested, to withstand asphyxiation under the conditions of the test —that is, the individuals can be given a just serial order of rating, or grouped in classes according to ability. It is to be hoped that there will be data available some time on the points of the significance of these relative ratings for absolute altitudes and durations, and as to their dependence on temporary psycho-physical condition of the individuals, and also as to the influence of temperature, wind-stimulation, nitrogen tension and mental excitement.

The research done in the development of the rating test laid a foundation for the development of tests of psycho-physical condition or "fitness," in which aviators are understood to show variations having serious bearing on their work and safety. (The slang term "staleness" is commonly applied to the condition of an aviator when he is markedly unfit to fly for psychological causes.) The development of such tests is relatively simpler than the task actually accomplished in the asphyxiation test, but the limitations of time, space and staff prevented definite accomplishment along this line, although substantial progress was made.

Towards the construction of such tests a tactual discrimination test devised by Captain Sparrow is an interesting contribution. Among the hopeful means also is the controlled association reaction. The solution lies, however, according to my belief, not in single tests but in methodical combinations as in the rating test.

There was no opportunity to investigate the important psychological factors summed up in the term "morale of the flier." These problems were committed to the "flight surgeons," * * * .

Some important observations were made on psychological causes of accidents (although no research was done). From accidents in the low pressure chamber, and from study of air acidents, it was made evident that the painful stimulation of air pressure inward on the ear drum, may (aside from any lesion of the membrane) produce mental incompetence, and apparent unconsciousness. Such stimulation occurs at times when exceptionally rapid descents are made: sudden increase on the external pressure actually tending to prevent on account of the physics of the Eustachian tube, the opening of the tube to equalize the pressure. Unconsciousness may also occur, as the asphyxiation work makes obvious, from the lack of oxygen, but these cases present features different from the above, the descent improving the situation since it increases the oxygen supply. It was at first thought that the sudden increase in oxygen-supply to a patient who had nearly reached the limits of his endurance, might make his condition temporarily worse, producing an "oxygen intoxication," so-called. The work on the rating test however shows conclusively that no such effect occurs; the effect of giving oxygen is beneficial, whatever the patient's degree of asphyxiation, although on account of the latent period (the time required for the carrying of oxygen from the alveolar air to the nervous system) the *symptoms* may increase for a few seconds.

Of the work carried on by Captain Stratton, I shall not speak, as I imagine he would prefer to report it himself. Moreover, my only function in regard to it was to secure its transfer from the Air Service to the Medical Service, thinking thereby to give him increased facilities.

* * * concerning the nystagmus test for aviation candidates, the Psychology Depart-

ment was authorized by the Officer in Charge of the Laboratory, and later by the board, to conduct experiments and secure data bearing on the question * * * . The specific point on which we commenced work was whether the duration of nystagmus after rotation is an index of the sensitiveness of the mechanisms for appreciating motion and maintaining equilibrium. Other questions raised outside of the laboratory, *e. g.*, as to how far the semicircular canals constituted the mechanism involved, or whether they were the sole mechanism, seeming to us to have no practical bearing on the issue.

Our first attack on the problem consisted in observations on circus performers, vaudeville stunters, and dancers, in the effort to determine the nystagmus-reactions of these individuals of demonstrated high ability in equilibration. These observations were started by Captain G. R. Wells, and after being discontinued because of the necessity of sending him to a field station, were taken up by Captain Bentley. The results of these observations indicated the necessity of attacking the problem of practise-effects by controlled experiments. I consulted a well-known dancing teacher in New York City, who advised a daily practise period of half an hour, prophesying striking results in two weeks.

The experiment was carried out by Captain Bentley, on five men, who showed "normal" nystagmus the first day, when tested by Captain Wales, who had had experience in conducting the nystagmus test on examining boards. This observation was checked by Captain Bentley by more exact methods. Each man was given turning at the "standard" rate—ten turns in twenty seconds—first in one direction, then after a brief resting period in the opposite direction, and so on, for approximately half an hour. The total time of turning during the half hour was between three and four minutes. At the end of each set of ten turns, the nystagmus duration was recorded by an admirable method devised by Bentley. Practise was given as near daily as possible, but was interrupted by Sundays and military duties.

The nystagmus duration showed a reduction from day to day, following the form of the usual practise curves derived from other experiments on learning and habituation. In a short time all the men had durations far below the official lower limits for passing candidates (16 seconds) and one showed no nystagmus at all. The equilibration of these men was certainly no poorer than when they showed the "normal" nystagmus at the beginning.

An interesting field for further work on nystagmus was opened up by these investigations, which however had gone far enough to settle the point of practical military importance. It would have been well to ascertain the effect of varying the rate of rotation, * * * , and as I and the other men concerned in the experiments were shortly transferred from duty with the Medical Research Board, the investigation lapsed at that point.

The tests * * * which were carried on in airplanes upon deaf subjects and others, we had nothing to do with. * * *

KNIGHT DUNLAP

THE JOHNS HOPKINS UNIVERSITY

THE MATHEMATICAL ASSOCIATION OF AMERICA

THE third annual meeting of the association was held at the University of Chicago on Friday, December 27, 1918, in conjunction with the annual meeting of the American Mathematical Society. Eighty-six were in attendance at the sessions.

The first session was devoted to the subject: "Deductions from war-time experiences with respect to the teaching of mathematics." This was a conference participated in by representatives of colleges and universities in which the Students' Army Training Corps were located, including R. P. Baker, University of Iowa; W. D. Cairns, Oberlin College; A. R. Crathorne, University of Illinois; D. R. Curtiss, Northwestern University; W. B. Ford, University of Michigan; A. M. Kenyon, Purdue University, and H. E. Slaught, University of Chicago. These men reported upon the methods used and the probable lessons to be gained for the future of collegiate mathematics. Professor D. R. Curtiss also gave an account of "An experiment in supervised study" this being followed by

a discussion by Professor H. L. Rietz, University of Iowa. "A report on the ensign school" was made by Professor E. J. Moulton and R. E. Wilson, of Northwestern University.

After a session of the American Mathematical Society, to which the members of the association were invited to hear the retiring address of President L. E. Dickson on "Mathematics in war perspective," there was a joint session of the two organizations at which the following papers were read:

Some mathematical features of ballistics: CAPTAIN A. A. BENNETT, Aberdeen Proving Ground.

How the map problem was met in the war: PROFESSOR KURT LAVES, University of Chicago.

Notes concerning recent books on navigation: ALICE BACHE GOULD, University of Chicago.

Statistics methods for preparation for war department service: PROFESSOR H. L. RIETZ, University of Iowa.

Ordnance problems: MAJOR W. D. MACMILLAN, Ordnance Department, Washington, D. C.

Practical exterior ballistics: LIEUTENANT P. L. ALGER, Aberdeen Proving Ground.

The effect of the earth's rotation and curvature on the path of a projectile: PROFESSOR W. H. ROEVER, Aberdeen Proving Ground.

On low velocity high angle fire: PROFESSOR H. F. BLICHFELDT, Aberdeen Proving Ground.

There was a joint dinner of the two organizations on Friday evening. The annual business meeting was held Friday noon, and the following officers were elected:

President—H. E. SLAUGHT.

Vice-presidents—R. G. D. RICHARDSON, H. L. RIETZ.

Members of the Executive Council for three years—L. P. EISENHART, B. F. FINKEL, E. V. HUNTINGTON, E. H. MOORE.

The report of the secretary-treasurer showed that eight members had died during the year, 61 individual and 4 institutional members had been added, 49 individual and 4 institutional members had withdrawn, the association thus numbering 1,060 individual and 84 institutional members. One hundred and ten members are known to the secretary-treasurer as having been enrolled in national service, including a small number in Y. M. C. A. and other non-combatant branches.

It was announced that the council had appointed R. C. Archibald, of Brown University, as editor-in-chief of the official journal, the *American Mathematical Monthly*, in place of R. D. Carmichael, resigned; and that twenty persons and one institution had been elected to membership at this meeting.

The financial statement showed a balance for December 1, 1917, of $3,485.47, receipts on 1918 business of $4,566.21, expenditures amounting to $4,539.84, and a consequent balance on 1919 business of $3,511.84, which with $216.27 already received on 1919 business gives a balance under date of December 2, 1918, of $3,728.11. This will be reduced to approximately $1,700 by bills payable on 1918 business.

W. D. CAIRNS,
Secretary-Treasurer

AMERICAN SOCIETY OF ZOOLOGISTS

SIXTEENTH ANNUAL MEETING

THE proceedings of the sixteenth annual meeting of the American Society of Zoologists are published in full in the *Anatomical Record* for January, 1919, together with abstracts of the papers presented.

The following were elected to membership in the society: Arthur Challen Baker, Bureau of Entomology, Washington, D. C.; Samuel Randall Detwiler, Yale Medical School, New Haven, Conn.; Harrison Randall Hunt, West Virginia University, Morgantown, W. Va.; Edwin Booth Powers, Colorado College, Colorado Springs, Colo.; William Hay Talliaferro, Chemical Welfare Service, New Haven, Conn.; Elmer Roberts, University of Illinois, Urbana, Ill.

C. M. Child, Chicago, was elected president; H. H. Wilder, Northampton, Mass., vice-president; W. C. Allee, Lake Forest, Ill., secretary-treasurer, and George Lefevre, Columbia, Mo., member of executive committee.

The following papers were presented:

Parasitology

On the transmission of two fowl tapeworms: JAMES E. ACKERT, Kansas State Agricultural College.

Recent discoveries concerning the life history of Ascaris lumbricoides: G. H. RANSOM and W. D. FOSTER, Bureau of Animal Industry, Washington, D. C.

The true homology of the cuticula and subcuticula of trematodes and cestodes: H. S. PRATT, Haverford College.

Comparative Anatomy

The metamorphosis of two species of cyclops: Cyclops signatus (C. albidus Jurine) and Cyclops americanus Marsh: ESTHER F. BYRNES.

The olfactory organs of Orthoptera: N. E. McINDOO, Bureau of Entomology, Washington, D. C.

General Physiology

The formation of buds "Tethya" buds in sponges of the genus Coppatias: W. J. CROZIER and BLANCHE B. CROZIER, Bermuda Biological Station for Research.

On the temporal relations of asexual propagation and gametic reproduction in Coscinasterias; with a note on the function of the Madreporite: W. J. CROZIER, University of Illinois, College of Medicine.

The olfactory sense of lepidopterous larvæ: N. E. McINDOO, Bureau of Entomology, Washington, D. C.

Sensory reactions of Chromodoris zebra: W. J. CROZIER, Bermuda Biological Station, and L. B. AREY, Northwestern University Medical School.

The relative stimulating efficiency of continuous and intermittent light upon Vanessa antiopa: WILLIAM L. DOLLEY, JR., Randolph-Macon College, Ashland, Va.

The rates of CO_2 produced by starved and fed Paramecia and their possible relations to the rates of oxidation in the unfertilized and fertilized sea urchin egg: E. J. LUND, University of Minnesota.

The photoreactions of partially blinded whip-tail scorpions: BRADLEY M. PATTEN, Western Reserve University, School of Medicine.

Excretion crystals in ameba: A. A. SCHAEFFER, University of Tennessee.

The reactions and resistance of certain marine lshes to H ions: V. E. SHELFORD, University of Illinois.

A simple method for measuring the CO_2 produced by protozoa and other small organisms: E. J. LUND, University of Minnesota.

The effect of KCN on the rate of oxygen consumption of Planaria: GEORGE DELWIN ALLEN, University of Minnesota (introduced by E. J. Lund).

The influence of temperature and concentrations on toxicity of salts to fish: EDWIN B. POWERS, Colorado College (introduced by V. E. Shelford).

Ecology

Further contributions upon the natural history of Chromodoris zebra; the question of adaptive coloration: W. J. CROZIER, University of Illinois, College of Medicine.

The zoological significance of the functional fenestral plate in the ear capsule of caudate amphibia: H. D. REED, Cornell University.

The coloration and habits of West Indian and Hawaiian reef fishes: W. H. LONGLEY, Goucher College.

Suggestions as to the climograph of deciduous forest invertebrates as illustrated by experimental data on the codling moth: V. E. SHELFORD, Illinois Natural History Survey.

On the nature and source of some adaptive features in the ethnology of Chiton: W. J. CROZIER, University of Illinois, College of Medicine.

Embryology

The anlage of endoderm and mesoderm in the opossum: CARL HARTMAN, University of Texas.

The œstrous cycle in rats: J. A. LONG, University of California.

Results of extirpation both thyroid and pituitary glands in tadpoles of Bufo and Rana: BENNETT M. ALLEN, University of Kansas.

Miscellaneous notes regarding experimental studies upon the endocrine glands of Rana and Bufo: BENNETT M. ALLEN, University of Kansas.

Effect of the extirpation of the thyroid gland upon the pituitary gland in Bufo: MARY ELIZABETH LARSON, University of Kansas (introduced by Bennet M. Allen).

Evolution and Genetics

The solitary and aggregated generations in Salpidæ: MAYNARD M. METCALF, Orchard Laboratory.

Correlation of fertility and fecundity in an inbred stock: ROSCOE R. HYDE, Indiana State Normal School and Johns Hopkins University.

The extent of the occurrence of sex intergrades in Cladocera: ARTHUR M. BANTA, Station for Experimental Evolution.

Inheritance of color in the domestic turkey: W. R. B. ROBERTSON, University of Kansas.

Nuclear reorganization and its relation to conjugation and inheritance in Arcella vulgaris: H. M. MACCURDY, Alma College.

Several ways in which Gynandromorphs in Insects may arise: T. H. MORGAN, Columbia University.

Duplication: C. R. BRIDGES, Columbia University (introduced by T. H. Morgan).

Exhibits

Demonstration of sex intergrades in Cladocera. A. M. Banta, Station for Experimental Evolution.

Models showing typical in the development of the human embryo. Department of Embryology, Carnegie Institution of Washington.

In addition to these papers the Ecological Society of America contributed the following papers to the joint program held on the evening of December 27:

The hydrogen ion concentration of the sea water of Puget Sound and the reactions of the herring (Clupea pallasii Cuvier) to hydrogen concentration in sea water: Edwin B. Powers, Colorado College.

The PH of Puget Sound in the vicinity of Friday Harbor varies with other conditions, tides, depths and locality. The herring reacts positively to a PH of 7.9 to 8.0. The reaction is positive to this PH concentration both from a lower and a higher PH.

Ecological investigations under the federal government: Harry C. Oberholser, National Museum.

The most important ecological investigation under federal government auspices are carried on as a basis for other work, and are of far-reaching importance. The Fish Commission studies the relation of fishes to their environment; the Forest Service that of trees; the Bureau of Plant Industry of various other plants, particularly with regard to plant diseases and plant introductions; the Bureau of Animal Industry, the life history of internal animal parasites; the Bureau of Entomology, the life history of insects in their relation to economic problems; and the Biological Survey, the relations of animals, birds and other animals to their environment and to each other, for the determination of the life zones of distribution.

The distribution of the internal parasites of the fish and other aquatic vertebrates of Oneida Lake, New York: Henry S. Pratt, Haverford College.

An important feature of the meeting was the conference between government and laboratory zoologists on Saturday afternoon. Subject: Methods of securing Better Cooperation between Government and Laboratory Zoologists in the Solution of Problems of General or National Importance; Professor C. E. McClung, presiding.

Papers on plans and problems of the Bureau of Entomology that can be furthered by cooperation with laboratory zoologists: Dr. L. O. Howard.

Discussion led by Professor J. C. Needham, Cornell University.

Paper from the Bureau of Fisheries: Dr. Hugh Smith.

Discussion led by Professor H. B. Ward, University of Illinois.

Paper from the Bureau of Animal Industry: Dr. B. H. Ransom.

Discussion led by Professor Herbert Osborn, Ohio State University.

Paper from the Biological Survey: Dr. E. W. Nelson.

Discussion led by Professor R. K. Nabours, Manhattan, Kansas.

Plans of National Research Council for advancing American Research: Dr. J. C. Merriam, vice-chairman, National Research Council.

Concluding discussion and proposal of definite plans: Professor C. E. McClung.

The proceedings of the conference will be published in full in a later issue of Science.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SECTION F, ZOOLOGY

The Convocation Week meetings of Section F were held in conjunction with those of The Society of American Zoologists at Baltimore, Maryland, December 26–28.

At the business session, Bennett M. Allen, Lawrence, Kansas, was elected member of the council; J. H. Gerould, Hanover, N. H., was chosen member of the General Committee; Herbert Osborn, Columbus, Ohio, was reelected member of Sectional Committee for five years, and W. M. Wheeler, Bussey Institution, was elected vice-president of the section for 1919.

In the absence of the secretary H. V. Neal in Y. M. C. A. service in Italy, the secretary of the zoologists, W. C. Allee, Lake Forest, Ill., acted as secretary for the meeting. W. C. Allee,

Secretary

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CONTENTS

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ZOOLOGICAL AIMS AND OPPORTUNITIES[1]

IT is hardly necessary to remind you that the stress of recent months has not been very favorable for the production of an address worthy of this occasion. I shall present no apologies or excuses for the shortcomings of my effort but it may be fair to state that the subject selected has been determined in part by the conditions of world turmoil through which we have been passing and the thoughts almost inevitably prompted by the rapidly shifting viewpoints in almost every phase of human thought.

Since we are human beings as well as zoologists it is natural that we should be confronted with questions as to the status of our science in the world problems of the day; the effects that may follow the immensely critical movements in human adjustments and, perhaps above all as to the bearing of our zoological knowledge, philosophy and instruction upon the shaping of human activities and human activities and human progress.

To merely state these questions would involve more time and a more comprehensive grasp of human affairs than I can claim; to attempt answers to them would involve prophetic vision as well as broad knowledge, but nevertheless I shall venture to present a few, perhaps disjointed, suggestions, believing them to be of imperative importance and in the hope that they may stimulate further interest and discussion.

It will help to form a basis for these suggestions to consider for a moment the method by which the science of zoology has developed and reached its present status. As with other sciences and human knowledge in general it

[1] Address of the retiring vice-president and chairman, Section F, Zoology, of the American Association for the Advancement of Science, Baltimore, December 27, 1918.

has been a matter of very irregular growth, now one phase, now another forging ahead; the mistakes of one generation being corrected by a later one and the faulty interpretations of limited knowledge clarified with wider basis of fact. Often the progress of one branch has been definitely halted till the developments in other fields have given the data necessary for a clear comprehension and satisfactory solution of its problems.

The rapid advance of one phase may have resulted from individual taste or interest or again from some insistent demand from an associated or dependent field. Comparative anatomy has been pushed forward by the needs of human anatomy; in fact many phases of zoology particularly related to medicine have had their progress determined by the needs of this applied science. The medical importance of certain mosquitoes and flies has stimulated tremendously the interest in these groups and the amount of study devoted to them.

Extremely destructive insects, from a human standpoint, have been investigated with far greater assiduity than is true of most of the species devoid of economic interest. Attractive habits or a human interest perhaps accounts for the fact that birds have been much more studied and are far better known than the worms on which they feed, and that ants, bees and wasps with social habits have claimed attention to the neglect of less highly specialized forms.

Primitive observations of the character and habits of animals, stimulated no doubt by the needs for food and the domestication of available forms, has grown into definite knowledge concerning the habits and life histories and other general matter. The study of animal activities must have been closely coincident with that of the animal mechanism and these gradually differentiated into the now almost too widely separated branches of morphology and physiology, while passing further into the realm of the interactions with surrounding forces or interrelations with other organisms has developed into the ecology of modern times. Recognition of the succession of generations of like animals laid the foundations for a knowledge of the main facts of heredity and these with later knowledge of the mechanism of inheritance gives us our modern conceptions of genetics.

Attempts to designate the various animals must have developed by slow degrees into the primitive recognition of species and quite naturally into the further association of groups of similar kinds such as birds, fishes, reptiles, etc., which were undoubtedly the beginnings of our systems of classification; systems whose complexities now sometimes become the despair of the initiated as well as of the amateur.

Comparison of the animals of different geographical regions involving the recognition of distribution, of adaptations to climate, topography and other natural features and to restriction of modes of life must have early entered into the realm of zoology. Curiosity as to the meaning of fossils grew with our sister science of geology into modern paleontology with all its significant contributions to the interpretation of life and its historic development.

Speculation as to the origin of animal life certainly came at an early date and the long tangle of conceptions of the processes of evolution which have culminated in our doctrine of descent was started on its devious path.

But it is not my purpose to trace in detail the growth of the different branches of zoological science. What I would like to emphasize just now is that we have a large number of quite distinct phases of our study and that these have become so specialized that the workers in one branch may have very little conception of the nature of the problems, the technique or the difficulties attending the advancement of knowledge in another branch.

In some cases this seems to have resulted in lack of sympathy or in misunderstandings that have served as a handicap to the progress of the science as a whole and a mutual recognition of the interdependence of all branches should be helpful in determining future progress. The truth is that there is no branch of zoology overworked or exhausted and there is

every reason for cordial recognition of the work being done in other fields than one's own specialty. Moreover, so dependent is one branch for its fullest development on the progress of related or supporting branches that any other attitude is to be deplored.

In a general way and for the purpose of my discussion we may separate zoological activities into two broad classes (1st) investigation, research or the accumulation of new knowledge and (2d) instruction or the distribution of this knowledge to the public at large.

In many ways the aims and methods of the two may differ and yet there is imperative need of the closest and most sympathetic contact between the two and among the workers in the different spheres. In many cases—and I believe most fortunately—the two functions are combined, but often such separation exists as to result in loss of effort or even conflict of action.

ZOOLOGICAL RESEARCH

It should go without saying that research must precede instruction at least as applied to any particular object although it would seem that this order is at times reversed.

We may sometimes discover quite munificent provision for education in a too narrow sense with little apparent recognition that the subjects covered are still little known or crudely assembled. Extended and careful investigation should be the first effort in order that accurate and useful knowledge may be available for instruction. Here too will arise the question as to the kind of research that should be given first and most insistent attention.

The point of view may be determined largely by the concept or ideal as to the ultimate goal of zoological effort. Have we a definite object or are we still, as in the early stages of our science, simply following attractive leads or the easiest trails to see whither they may carry us? Is it our greatest ambition to produce a zoological structure complete and perfect in itself as a scientific ideal or to give earliest and most effective service possible to all the agencies operating for human progress and human welfare? Shall our immediate efforts be given to questions of most remote concern to present problems of life or shall we concentrate effort on those phases which by their relation to medicine or to industry have vital bearing on immediate human needs? Such questions must have come to many of us when searching our innermost thoughts for evidence as to what we could do to help "win the war." Such questions may well concern us in the history-making period that must now follow in the establishment of order and a new alignment of human relationships and activities and which must necessarily be of world-wide scope.

Perhaps we may reflect that these questions will be largely settled by the tastes and choice of the many individuals concerned and that the outcome will be a fairly well-balanced combination. Nevertheless it is evident that the question will come as an urgent one to many individuals and will affect their attitude both in research and instruction so that some sort of decision as to the direction of greatest emphasis will need to be made.

Admitting, however, that the final goal is economic advantage, the development of applied science for the betterment of human society, we may still inquire as to the route to the main objective. I would certainly be one of the first to accord a high place to all phases of science that have made and are making for human advancement. Human society is not only our greatest achievement so far but it offers the only basis we know for evolution and progress in conditions of world affairs that should make this earth the fittest place possible for human life.

But we must guard against a too narrow view of the values in scientific knowledge. That which is of the most immediate concern may be but temporary in its application and some of the most vital and enduring things may be less apparent.

It is fortunate therefore that along with the many agencies that are attacking the immediate problems of applied science we have numerous agencies interested in the explora-

tion and investigation of fields whose immediate contribution to human welfare may be difficult to discern. It is a well-known fact that many of our most important advances in applied zoology have been possible only with the basis of knowledge acquired in some field that seemed quite unrelated to human affairs. Instances will occur to all but such stock examples as the ecological relations of trichina, liver fluke and other parasites may serve to emphasize the point.

It may be suggested then that one of the great objectives for the immediate future is carrying forward our researches on all fronts, that we may secure cooperation and correlation in the various lines and that we aim at a more complete and perfect combination of fundamental knowledge, which may be accessible from all sides for the furtherance of such applications as may be needful in human progress.

Whatever our objective, it is interesting to inquire as to our conditions for progress, the lines of work that we may see most clearly ahead of us, the agencies through which we may press for their attainment and the helps or handicaps that are to be reckoned with in our efforts.

I feel sure no one will question the need of continuous effort in the line of structure both general and histological or of function and activities in the widest sense for tissues, organs and individuals. These constitute such an imperative basis for all work in embryology, life-history, activities and relationships that only the most superficial view would permit of a lessening of effort in these lines.

As we go further in economic lines we appreciate more and more that the control of organic nature for the advantage of man must be based on the most complete knowledge of the structures, functions, habits, responses and relationships of the organisms with which we must deal. Can we say of any animal that we know all about it, that needs to be taken into account, when we attempt to fix its place in nature or with reference to the organisms with which it may be associated?

Have we by any means exhaused the problems of structure, the physical factors in animal symmetry or correlation of organs or of the activities of animals in many phases. What of the mechanics of flight or aerial locomotion as exhibited in various groups? How do certain insects hover or fly backward, as in many different families or even fly upside down as is claimed for certain tabanids. And once these questions are satisfactorily answered there will still arise the question as to how such complicated activities had their origin, what were the structural bases on which they were built and what the forces that have operated in their evolution. Even the ultimate problem as to the nature of life itself must be solved, if ever, on the basis of those organic forces which though possibly only combinations of simpler chemical or physical forces are so indissolubly linked with organic structure that this must be our base of attack.

To enter another field and one of recent important strides, consider the wealth of unsolved problems concerning the relations of animals to their environment and to each other. These present, especially for the biological factors, some wonderfully intricate associations and the determinations except for a given time and place, perhaps, an impossible task, since the various elements are in constant process of change. But many of the more constant factors may be determined with approximate accuracy and allowing for periodic variations may afford a basis for some valuable deductions, even possibly, for useful economic practises. To cite a particular instance let me mention the study of the short-tailed shrew by Shull. Here is a species seldom attracting attention but widely dispersed, occurring in great abundance and with a variety of food that includes a large number of species that we consider very injurious along with many that are innocuous or possibly even beneficial. Doubtless we would find a different bill of fare for the species for every month of the year and possibly for every field in which we might study it, but the total appears to be decidedly in the animals favor.

The relation of birds in agriculture has been a most debated and debatable question and largely because of the inconstancy in food habits of many of the most familiar species. Considered strictly from an economic point of view there is little doubt that the status of many species is still open to investigation. So too the place of spiders in the ecologic association is one of much complexity along with that of a host of predaceous and parasitic forms. A phase of their relationship that seems however to be often overlooked is that except for the abundance of the species on which they subsist their presence in any given association could be dispensed with. Since they are dependent on forms that again are dependent on vegetation it is obvious on second thought that all such forms are indirectly a drain upon the plant element and, speaking agriculturally, might best be wanting if the host forms were absent.

I need not weary you with further examples but submit that here is a field of work of intense interest biologically, offering an infinite number of fascinating problems, calling for the finest ability in field observation and laboratory analysis and promising results of decided importance for economic applications in agriculture, forestry, fisheries and many other fields.

These animal associations lead quite naturally to the conditions shown among social species and these social organizations among various groups of animals, as also the psychology of the lower animals, offer much that is suggestive for the sociologist and psychologist and certainly there should be some point of contact for students in these various fields. It is only upon such broad biological foundation that we can build a rational sociology or philosophy both for zoology and for human life.

Certainly one of the great aims in our science is to discover as rapidly as possible all the forms of life that inhabit the earth and, I may add, all those for which we can gain evidence of existence in the geological ages of the past. Only with this knowledge in hand can future students expect to reach the most conclusive knowledge as to the inter-relations and interactions of the organic world or the derivation, affinities and possible relation to human interests.

Zoological exploration has been a favorite activity in all the periods of zoological study. I see no possibility that its interest can lag so long as there are unexplored fragments of the earth's surface or the waters or the air surrounding it or unknown forms of life to be uncovered. Indeed with the greater facilities possible in modern transportation and communication we may expect a great impulse for this kind of work. "Impenetrable jungle" and "inaccessible" mountain peak may be brought within easy access of the modern airship while continuous means of wireless communication will greatly favor such enterprises. No doubt our zoological explorers will take advantage of these means and add tremendously to their contributions to science, and, probably, to the world's sources of wealth, convenience or enjoyment.

And what of our taxonomy? Will future generations be content to endure some of the enormities perpetrated under our system of nomenclature? Names we must have and recognition of specific, generic and other natural groups of organisms, so also uniformity and stability for the world of science, but I certainly have deep sympathy for the morphologists, physiologists, cytologists and other workers who must perforce use some name to designate the material on which their work is based and who find a most chaotic assemblage of names from which to select. Of course systematists are not alone in such troubles, as the terminologies of morphology, cytology, etc., appear to have some uncertainties of their own.

It is to be hoped that the efforts of the international commission may be supported and their work now pushed forward with renewed zeal. With closer and more universal relationship between workers in all countries it becomes more and more essential that we have a recognized and established system for all languages and all groups of animals. Especially important is the fixing of such names as are most generally used in research

and education, as here is where the burden falls most heavily on the workers who are not systematists. No taxonomist should have the heart and if possible should not have the power or the opportunity by shifting a genus or rearranging species to foist upon a patient world the necessity of adopting a new combination in the name of the common species universally referred to in anatomy, medicine, agriculture or other lines of applied science.

I have elsewhere hinted at the discouraging nature of these nomenclatural acrobatics to the student entering on zoological work. I have good reason to believe that many promising and brilliant young workers have been disgusted and drawn to other fields of effort because of the complexities and apparently senseless chaos involved in the synonymy of many of our common animals. Think of thirty-six different specific combinations for the oyster-shell scale (that is 36 the last time I had occasion to note the number) or twenty-six for the screw worm fly.

Particularly aggravating are such cases as the mosquito, cattle-tick and other forms related to disease and necessarily used by medical students. Clearly one of the most helpful things in zoological education would be a condition of stability in nomenclature which would permit us to assure our prospective zoologists of the coming generation that they would not have to learn and unlearn a succession of scientific names for the things with which they deal.

Some cases would be amusing if they were not so tragically wasteful in valuable time. I recall a student of cytology who was greatly puzzled because the chromosomes of two supposedly distinct species under different generic names were exactly the same, and whose relief may be imagined when he learned that they were one species identified from different collections under names of different vintage. He might well have been disgusted as well as relieved.

It is rather dangerous to suggest remedies or reform in this line but I venture to offer one, which is that systematists curb their desire to form new genera and limit these so far as possible to new species or use special care not to shift into a new genus any of the common species whose names have been for a long time in general use. The concept of genus is an indefinite one; more than the species it may be subject to wide individual interpretation, but to multiply generic names and so necessitate the renaming of a great number of common well-known species is a most lamentable affair. To do it without most essential taxonomic needs is indefensible. To do it because some other group has a greater ratio of genera to species, as recently advocated by a well-known authority in a certain group, seems to imply a total disregard of the real needs and purposes of a nomenclatorial system.

ZOOLOGICAL PHILOSOPHY

The great problems of human society, racial, sexual, industrial, commercial, have their basic foundations in conditions that are fundamentally zoological—that is, dependent upon the animal nature of man and having their roots far back in the soil of animal life of which man is a part, even if he is the most recent and dominant of the process of evolution.

Whether we will or not, we must recognize these inherited conditions and capacities of our species and may well consider in what regard the fundamental laws of evolution apply to present-day problems of human development. Shall we still adhere to the idea of brute force as the determining factor in the survival of the fittest or shall we adjust our vision to the conception of ideas of justice, morality, love for the beautiful and of ethical standards as the highest and most advanced product of that great force of evolution which we, as zoologists, most confidently accept as the method of the universe? Shall we do our utmost to preserve and develop these latest, finest, most attractive products of evolution or permit them to degenerate like vestiges of unused organs?

Possibly I may have been alone, but I suspect that many of my zoological friends have found the past few months a time of soul-

searching questioning and review of our accepted beliefs in organic evolution, to discover if possible whether there is any warrant for the claim that they can be made to support and justify, even in distorted form, such unspeakably inhuman activities as have followed in the wake of the attempt to establish domination for a self-styled superior race. Of course we may now interpret the result if we choose as establishing the place of the triumphant side in the contest, but I do not think we need stop to argue concerning the "fittest" in this "struggle for existence." There is too much to be done, too many vital issues at stake for human progress in the immediate future and all our resources in thought and action will be demanded in their solution. But, granting all this, must we not face the cold fact that our basic principle in organic evolution is capable of misinterpretation or misapplication when it is in any way possible for it to be invoked as the justification for starting such a train of misery and death to the nations of the whole world? It takes remarkable optimism concerning the betterment of mankind as the results of this war (and unquestionably betterment may come in many regards) in order to feel that the evolution of our human family to higher conceptions of order and cooperation in national affairs could not have been achieved without the tremendous, monstrous cost of such a war.

Ought we not in all fairness to a biological principle which we believe to have been the basis of all our achievements in morality, altruism and ethical standards of human society to see if possible that its basic principles, its proper interpretations and its proper results are so impressed upon our biological thought and policies of education that zoology as a science can never again be charged with such infamous doctrine as a support for the divine right of kings or the origin of a world war such as has agonized the nations of the present day.

The growth and progress of science itself has so much at stake that, even with a narrow selfish interest in the advancement of our special branch of study, we can not be indifferent, but as part of a greater educational world and a still greater world of human activity we owe it to ourselves and our science that our principles be not only well established, but that they are correctly interpreted to the world at large. We have here not only a great aim but a great and most significant opportunity. If our statesmen can be brought to think and act on the basis of a most enlightened biological interpretation of the world and human society, I believe we need have little fear for the safety of future generations.

AGENCIES FOR RESEARCH

In organized agencies or zoological research we certainly have reason to be proud and to feel that we have the basis for extensive enterprises and rapid development. The governmental bureaus of Biological Survey, Fisheries, Animal Industry and Entomology, which have been contributing very largely to the growth of zoological science in recent years, are facing new opportunities and will have had their activities stimulated by recent events. While they have no doubt been handicapped by the temporary or permanent loss of many of their workers it is certainly to be expected that they will resume their work with renewed zeal and efficiency.

In the universities, colleges and experiment stations where there has been perhaps the heaviest drain on the younger workers, who naturally form a very large per cent. of the active force, there should be prompt resumption of activity and researches along many lines that have been suggested by problems faced during the war, which will offer unlimited opportunity for ingenuity and original investigation. So to the museums, state academies, surveys and all the institutions interested in exploration or research will spring to renewed activity.

In view of the many agencies of this kind and the large support given to zoological research it is fair to ask whether we are getting the utmost in return and whether there are any tendencies in these organizations inimical to the most effective results? It is perhaps hardly to be expected that we have an ideal

condition of ample support for research with untrammeled freedom both in subject and method of work. It does seem fair to expect and demand that the necessary administrative restrictions, committee approvals, financial safeguards, and all the other factors of delay and annoyance to the investigator should be reduced to the lowest possible minimum.

EDUCATIONAL ASPECTS

To the thoughtful student of zoology and especially, I think, to the teacher who reflects upon the relation of his subject to the development of scholarship and character, or its relationship to the general welfare and advancement of human society, a question that now looms large on his horizon is whether we are using this material and effort in the way to secure the greatest benefit.

Our systems of instruction have been developed largely with the traditional methods for other subjects in mind, or often with the necessity of adapting work to schedules or methods in vogue in other quite different fields of knowledge. Even didactic methods have been more or less forced by influences quite out of harmony with biological spirit and needs.

That these have been unsatisfactory in many ways has been attested by many efforts to break away from the conventional plans, but possibly most conspicuously by the establishment of the many summer schools, field stations, or laboratories where biologists may handle instruction on plans adapted to the material and to the conditions under which life exists and under which it should be studied.

Unfortunately, this method has been developed mainly with reference to mature individuals and, while the service rendered through teachers with such experience and training may be of great value, it would seem entirely unnecessary to argue for such a plan to be applied to beginners as well. Indeed, many of the summer camps for boys and girls, the activities of the boy scouts movement and courses now offered in some schools give evidence of attempting such methods, but if of advantage for the few why not for the many and why should not the essentials of such method be utilized to the greatest possible extent for all pupils who enter on the study of living things, and which as living things, should be studied under the conditions which recognize the life factor!

Perhaps, to state my view in brief, I would say that the first instruction in zoology should be training in observation. The natural curiosity of the pupil concerning the living things about him should be stimulated and gratified, not smothered by the cold reception of unsympathetic teachers. If connected with the practical biological problems of his daily life I believe it will be all the more effective.

If the subject is taken in the high school it may advance to some of the most obvious facts and principles of biology, but it seems to me this period should be concerned much more with recognition of facts and giving acquaintance with living things, than with attempts at the more profound generalizations. If the student has his interest stimulated and carries his study further, this foundation will be far more valuable than a drill upon speculations the nature of which is beyond the comprehension of the immature mind. If he never gets beyond this stage it will serve him far better for the problems of life than hazy notions of zoological theory.

A somewhat similar view applies to the general or introductory course in zoology for the college, which should be planned for the great body of students who take the subject as a part (and, I believe, a most essential part) of their general education, not for the very small percentage who may later become professional zoologists. That is, the first demarkation should come after the more fundamental basis has been laid for the good of the specialist as well as for the sake of the majority whose school work in the subject stops with the one course.

Obviously the content of the course and the method of treatment should be adapted to the maturer minds and may deal with significances and interpretations as well as facts, but in a broad way should follow the same

principle of personal contact with the material on which the instruction is based.

Just now the content of the first college course and the time allotted to it seems to me to be of very grave concern, as many influences are operating to change its status.

To ignore or minimize these is to endanger the position already secured after many years of effort and to me this is to endanger the whole fabric of our educational system, as I deem the biological point of view and mode of attack of the greatest concern to a properly balanced and rounded education.

The great increase of subjects offered in our elective systems of education; the constant effort of the devotees of each branch to secure more and more time with minuter subdivisions of subjects or greater numbers of students, results in the practical elimination of certain subjects from the curriculum for many individual students. The demand of special, technical or professional schools for certain phases of the subject, or its limitation to very meager time, threatens to reduce the time and scope of work with serious disadvantage to both teacher and student. The call for special courses is highly encouraging as an evidence of the place zoology has come to occupy in these fields, still the supposed wants of medical, dental, sociological and agricultural students puts a serious strain upon the teacher who feels that there are certain fundamental things that are essential to proper handling of any subject resting upon biological foundations.

Moreover, under the stress of national emergency, we have been straining to give intensive or specialized courses containing the greatest amount of essential matter, especially economic, in the shortest possible time. Whether we will or no, there is likely to come the view either to the student or the administrator of student curricula, that if such intensive courses are effective in an emergency they might well be useful at other times, In any case we may be obliged to face the alternative of giving what seems zoologically most necessary in briefer courses, or seeing many of the students who ought normally to get the training it affords disappear from our laboratories.[2]

I feel very certain, however, that whatever may be necessary in the way of concentration or reduction of time, we must insist on a proper balance of the various fundamentals in our subect, a proper combination of morphology, physiology, ontogeny, ecology, genetics, distribution, evolution, taxonomy and the basic principles of economic practise, as essential to a proper perspective and to any recognition of the proportion and values, the omission of any one of which will result in imperfect views.

To borrow a simile from the field of animal nutrition we must have a balanced ration to ensure symmetry of growth and completeness of development and I can not approve efforts to give introductory courses based on any one of these elements to the exclusion of others no matter how fundamental and necessary they may be to the structure as a whole.

In the same way I can not endorse selection on the base of any one group of animals. While it is true that practically all biological principles may be illustrated within the confines of a single class of animals such limitation must necessarily result in a narrower conception of the animal kingdom as a whole.

I confidently believe that almost every phase of life can be found among the insects and, as a specialist in Hemiptera, I have often had occasion to remark that this one group of insects can easily be made to exhibit the greatest variety of biological principles. The same no doubt can be claimed by the specialist in almost any general group. But to make such a selection in our elementary training courses

[2] I note in a recent number of Science (November 22, 1918) in an article by Professor Bradley M. Davis on "Botany after the War" that the same questions concerning instruction in botany are confronting our brothers in biology and it is very evident that much may be said in one branch which will apply with equal force in the other. The important point for us is to decide whether we shall rise to meet the new vision and either justify and defend our present standards or adapt them to coming needs that may require new alignments.

would, it seems to me, defeat many of the most important objects of our college work.

There may well be differences of opinion as to the sequence and proportion of the different phases of zoology to be contained in the introductory course. I grant too that some latitude may be allowed for the preferences and training of the individual instructor but, conceding this, it seems to me that there are certain fundamentals that should be provided for at some period or in some form in any course that claims to give the student the basis either for further work in zoology or for the general problems of life or their applications in agriculture, medicine or commerce.

Morphology must certainly stand as one, if not the first, of these fundamental points, not only because it forms the essential basis for all taxonomic, biologic, faunistic or other work but because it is *par excellence* the part of zoology which once learned is a permanent foundation for the shifting structures of biologic interpretation. Whatever speculations may follow as to significance, function, origin, etc., the organs and their parts remain a basic fact practically unchanged from generation to generation and the final resort in all controversy in biological interpretation.

Just how much laboratory dissection or anatomic demonstration is absolutely necessary may be open to debate but as to its essential character I think we must all agree. Next and closely associated with morphology I place physiology, because the activities of animals are certainly of vital consequence in all developments of biological knowledge. Moreover, it is only on the basis of their functions that animal structures can be properly understood. I sometimes feel that it is regrettable that physiology and anatomy should have been so widely separated in more advanced courses, although this is in some degree an inevitable result of specialization. But certainly for elementary courses such separation is indefensible.

The extent and character of the physiological element, however, is subject to wide variation with different instructors and a proper balance may be hard to determine. From the nature of the case it is impossible to carry this phase into the many debatable fields of physiologic interpretation and I believe the best results will be secured by centering attention on those functions most easily associated with the structures studied. The well-established facts of digestion, circulation, respiration, excretion, nervous activities and reproduction can best be presented in connection with the study of the organs involved and if these are taken up in a comparative series of the major groups of animals, the nature of these fundamental activities should be firmly fixed in the mind of the student. Reproduction especially, with the associated phenomena of growth, metamorphosis, inheritance, etc., can most profitably come in as parts of a progressive system leading from lower to higher forms not only to show the gradual evolution of the system but as a most natural and desirable introduction for the presentation of sexual hygiene so vitally important for the happiness of the individual and to the perpetuity and progress of the race.

Ecology for the introductory course should be given large attention, but rather as a means of fixing the significance of structure and activity than as a separate field of study. So too the economic relationships may be profitably treated as associated with function and ecology.

The main facts of geographical distribution may have been suggested in the discussion of various animals, but discussion of migration and adaptation can hardly be omitted in a summary of biologic factors and with the foundation of a comparative study of the great groups of animals with indication of their historical development, the basic principles of the evolution of animals may be undertaken.

The amount of time accorded to classification is again a matter of great difference of opinion and practise. With the more special problems of taxonomy it is certainly unwise to deal in a class of general students. Puzzling and intricate problems of taxonomy should be presented to technical students in later courses and in much greater detail than would be

possible to a general class. But to omit the broad foundations of classification or to neglect its connection with its morphological basis is to lose one of the best mental disciplines and also to leave the student without that systematized grouping of facts with which he is dealing, that is so fundamentally essential to any clear grasp of correlations, or the orderly handling of facts that present themselves in the course of his life. I know of no discipline better, to give training in the systematic arrangement of matter than through the basic principles involved in the orderly arrangement of the myriad forms of animal life.

Above all of course we should have freedom of action for the individual teacher. The best in any teacher may be expected only when he can give his whole heart and enthusiasm to his work. I believe that it is possible with intelligent and sympathetic cooperation to secure both this freedom of action and a well-balanced and correlated agreement on the main content and aim of instruction and with this goes opportunity and responsibility which we need not attempt to measure.

I make no apology for introducing what may seem at first sight a rather primary and academic discussion in this line. We must all recognize that the ranks of our future zoological workers must be recruited in large part if not entirely from among the students of our high schools and colleges. It is certainly most vital to the progress of our science that we secure our share of the best talent represented among such students. It is of even greater consequence that the coming generation should have such fundamental training in the activities of life that they may be best qualified for citizenship.

I have purposely omitted any detailed discussion of the more advanced courses of zoological study offered in our college or university curricula, partly because I feel that there is the greater need of careful, constructive attention to our introductory courses, which should by all means have the advantage of the most able and experienced teachers, and partly because the drift and detail of the more specialized courses will be in considerable part a response to the changing demands of passing years. Our product of the advanced training should certainly provide us with qualified investigators and teachers in the many phases of zoological work. There is, however, I fear, a tendency to meet so many of these purposes that we are in danger of offering entirely too many special subjects as courses for undergraduate students. Zoology has perhaps not gone to the extreme of certain other departments of education, some of which appear to me entirely out of reason, but I find for instance in one of our well known schools no less than 57 different subjects offered as regular lecture or laboratory courses. Could not many of these more profitably stand as subjects for the individual student in seminary or graduate work or ought not the student with proper biological foundation to be able to follow them up independently after cutting loose from the leading strings of his academic instructors. Some of his time as an undergraduate ought certainly to be allotted to work that will give him the spirit and method of research, so that with separation from direct supervision he may meet the responsibilities and opportunities of adding to science with whatever talent and resource he may possess for original work.

EXTENSION ACTIVITIES

Within the last few years we have witnessed the organization of a plan of extension activities in education which is nation-wide in scope and the full significance of which, at least for zoology, I suspect we have failed to fully realize. The support available through the Smith-Lever act, while relating particularly to agriculture and home economics covers these in a broad way and, even in a rather close interpretation, must involve extension activities in biological lines, and zoologists will fail to meet their opportunities if they do not energetically occupy this field of endeavor.

That the field is pregnant with great possibilities may be surmised if we but review the

host of connections existing between zoological knowledge and agricultural practise. Not a single farm product but is affected directly or indirectly by some animal activity and the extent of unutilized zoology available is perhaps equalled only by the ignorance and indifference of a large part of the population most in need of accurate and intelligible information.

Some twenty years ago I took occasion to say in an address before the Association of Economic Entomologists that

> The problem or how to reach with the facts we have gathered the people for whom we work is one of the most difficult to solve. . . . No matter how carefully we experiment, how accurate and useful our results, we must place these results before a public uneducated in the details of our science.

The situation there referred to, though no doubt improved, is in some degree true to-day, but for a large part of the gain I believe we must credit the various extension agencies which have been developing in recent years.

Possibly some measure of this gain may be found in the enormous growth of the use of insecticides for the control of certain farm and orchard pests.

CONCLUSION

Finally then, in sum, I think we may say in confidence that zoology with its centuries of development stands as a great achievement of human thought and study; that it offers unlimited opportunity for further research and growth and that its aims and opportunities deserve the most ardent effort of its devotees.

Here at the most conspicuous milestone perhaps ever erected in the progress of the human race the passing generation of zoologists may hand on to the coming workers not only the product of generations of effort but the priceless opportunity of unsolved problems, the gift of possible achievements for many generations to come.

I appreciate that this is not a valedictory or an address to a graduating class and I beg pardon if I overstep the proprieties of the occasion, but the conditions of the day have impelled such appraisement of the situation and the occasional taking account of stock is perhaps at times a most necessary and profitable step in our undertakings.

I realize that there are many here present whose range of study and point of view must enable them to see with wider horizon and clearer vision the great domain, small tracts of which it is our individual function to cultivate, but I trust I may have your unanimous agrement to the sentiment that these various activities, so hurriedly sketched, so inadequately presented, are worthy of our most enthusiastic endeavor, our most loyal devotion and cooperation.

Herbert Osborn

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND SCIENTIFIC ORGANIZATION

The revised constitution of the American Association, presented at the Baltimore Meeting for adoption at the St. Louis Meeting, contains the following articles:

ARTICLE 6. DIVISIONS AND BRANCHES

Regional Divisions and Local Branches of the association may be formed by vote of the council. Such divisions and branches may elect officers, hold meetings, appoint committees, enter into relations with other societies, and promote within their fields the objects of the association.

ARTICLE 7. ASSOCIATED AND AFFILIATED SOCIETIES

National and local scientific societies may, by vote of the council, become associated with the association. Those associated societies which the council shall designate as affiliated societies are represented on the council and on the sectional committees as provided in articles 4 and 5.

These articles state the policy of the association as framed by the council in recent years. All the national scientific societies, including the great engineering societies and the American Medical Association, are now affiliated with the association and represented on its council. A Pacific Division has been formed which serves as a center for the scien-

tific societies and the scientific men of the Pacific Coast. A beginning has been made in the establishment of local branches and toward the affiliation of state and city academies.

At the Baltimore meeting of the association the committee on organization and membership, with the retiring president, Professor John M. Coulter, of the University of Chicago, as chairman, was instructed to take up these problems, and in the first instance more especially in the Central States, in view of the fact that the next two meetings will be held in St. Louis and Chicago.

Consideration should be given by men of science in the Central States to the desirability of forming a division to promote scientific work and scientific organization in that region. The association meets once in four years, successively in New York, Chicago and Washington. These are special convocation week meetings in which it is hoped that the scientific men and organizations of the whole country will take part, including those concerned with engineering, medicine, education, etc., and those devoted to the languages, history, economics, etc.

At the intervening two-year periods, the association will hold its meetings in large cities and these will also be large meetings. At the intervening alternate years the association plans to meet in smaller cities and university towns, and many of the affiliated societies will hold their meetings separately. It might be desirable on these alternate years to hold regional rather than national meetings, or it might be well for other divisions to follow the plan of the Pacific Division and hold meetings at some other time, as at Easter, at Thanksgiving or in the summer.

Apart from the formation of a Central Division the relations of the scientific academies and societies of the Central States to the national association deserve careful consideration. The American Medical Association is organized on the basis of state and county associations; the American Chemical Society has well-organized local branches; the National Education Association is at present considering similar plans.

The duplication of existing organizations should be avoided and the question arises whether the American Association could not enter into mutually helpful relations with the academies of science which are now doing useful work in the Central States and in some of the cities. The association is ready and anxious to arrange an affiliation which will leave the academy absolutely free and uncontrolled by it, but will allow the representation of the academy on the council which directs its activities and should be the body most influential in the organization, advancement and diffusion of science in America.

If all members of an affiliated academy become members of the association, part of the association membership fee of three dollars is returned to the academy for its expenses. Thus for $2.50 or $2.00 the member has the privileges—membership in the national association and subscription to the national weekly scientific journal—which in England cost $15. It is, however, not necessary for members of the local academy to become members of the association.

After an affiliation has been effected between the American Association, the national scientific societies and the state and city academies, it will be possible to coordinate with these the societies and clubs which exist in smaller centers and to established them where they are needed. An organization of this character is strictly scientific and democratic. The association has no control over the affiliated societies and academies, but becomes in effect an association of these societies, enabling them to cooperate in all directions where union is desirable.

The time is now particularly auspicious for scientific men to unite to obtain increased opportunities for their work. It is realized by all that science and the scientific men of the country were leading factors in bringing the war to a quick and favorable conclusion. The applications of science have enabled the country to amass the immense wealth which

could be devoted to the purposes of the nation; our scientific men were able to meet on terms of equal performance those of every other nation. In like manner it is agreed that science and scientific workers have a great part to play in the reconstruction period on which we are entering. The whole future of the nation rests on the proper development and distribution of our resources in natural wealth and in men. We must now decide to lead in scientific research and in the applications of science for the welfare of the people of the country.

This requires education and organization. Every scientific worker and all those who appreciate the fundamental place of science in national welfare should unite to do their part through our scientific organizations. They should be members, and active members, of the special society in their field, of their local society or academy, and of the American Association for the Advancement of Science, and these bodies should cooperate to advance their common interests.

The next meeting of the American Association and its affiliated societies will be held in St. Louis, beginning on December 29, 1919, to be followed by a meeting at Chicago a year later. The occasion should be taken to strengthen the association and its work in the central states, which have in recent years assumed such leadership in scientific research. It would be well if the meetings might be celebrated by the affiliation with the association of the strong state and city academies of the central states and the organization of a central branch of the association on the lines that have proved successful on the Pacific coast.

SCIENTIFIC EVENTS

THEODORE ROOSEVELT AND THE SOCIETY OF AMERICAN FORESTERS

Theodore Roosevelt was an honorary member of the Society of American Foresters. The following resolution was adopted as an expression of the esteem in which he was held by the members of the society:

In the death of Theodore Roosevelt, the Society of American Foresters mourns the loss of its greatest, most brilliant and most effective leader. The early growth of the profession of forestry in the United States was intimately bound up with his statesmanship while President. As a leader of the conservation movement he brought forcibly home to the American people the need of wise use and protection of the natural resources of this country. The crystallization of the conservation policy and the realization in large measure of forest conservation was one of the greatest achievements of his administration, and of profound significance in our progress toward national efficiency.

As a lover of nature and the out-of-doors, he was keenly interested in the forests, mountains, streams and wild life. As a traveler and explorer he expanded our knowledge of the forests of remote regions, both in Africa and in South America. By his proclamation, 148,000,000 acres of national forests were set aside—an amount three times the total proclaimed by all other Presidents since 1891, when the making of National Forest reservations began. It was in his administration and largely because of his advocacy that a true national forest policy was made possible by the transfer of the national forests from the Department of the Interior to the Department of Agriculture, in order that these forests might be placed under technical supervision. He realized the need of technical foresters in this country for the realization of this national forest policy, and therefore actively furthered forest education. He became an honorary member of the Society of American Foresters and, while President of the United States, addressed the society upon the ideals and duties of the American foresters. This address still remains to its members an inspiration of high purpose and of public service. As long as these ideals remain the guiding principle of the profession, the society will remain in the forefront of progressive thought and action in this country.

RESOLUTIONS IN MEMORY OF PRESIDENT VAN HISE

The following resolution in memory of the late President Charles R. Van Hise, of the University of Wisconsin, was unanimously voted by the Wisconsin Senate on January 8:

Whereas, President Van Hise was a Wisconsin man, born and reared on one of its farms, educated in its schools, and university, throughout his life a citizen of the state and devoting his energies to its service. He became a member of the University of

Wisconsin in 1875 and there continued until his death, forty-three years later, as student, teacher, investigator and president.

As student he won the highest honors of the university, and as teacher he made his department a power both in general education and in the production of professional geologists. Trained as a geologist in our university and in the study of problems offered by our state, his ability and insight earned for him the recognition of the scientific world of all nations for his masterly solution of the most difficult and fundamental problems of geology.

The characteristics which made him a great teacher, a great scholar and a great investigator, he continued to display to the full as president of the university. He had a singularly clear, noble and growing understanding of the duty of a state university to its commonwealth and he led the university far in the performance of that duty. He multiplied and strengthened the vital connections between university and state; not only developing and enriching its scholarship, but also carrying knowledge and light to all parts of the state and to all phases of its life. Thus the University of Wisconsin, under his guidance, became an example and a leader among the civic institutions of learning in the nation.

Dr. Van Hise contributed much to aid state and nation in questions of public policy arising from conservation, the control of industry and the newer development of international relations. To them he brought the same power to analyze problems and to present their solution which marked his work a science. Now, therefore, be it

Resolved by the senate, the assembly concurring, That the legislature of the state of Wisconsin expresses its grief in the death of President Charles Richard Van Hise and records its gratitude for his distinguished service rendered to the state through many years. With grief for the untimely death, with profound regret for the irreparable loss, the legislature expresses Wisconsin's just pride in her son and records the inspiring story of his public services and the noble devotion of his life.

AN INTER-ALLIED FELLOWSHIP OF MEDICINE

WE learn from the *British Medical Journal* that Sir W. Arbuthnot Lane presided over a meeting at the house of the Royal Society of Medicine on December 4 to consider further the desirability of forming an association for cooperation in medicine among the English-speaking countries, but not limited to them. Among those present were Major J. H. Means (U. S. A.), Lieutenant-Colonel Castellani (Italy), and Professor Weinberg (Paris). The acting honorary secretaries appointed at a previous meeting were Sir St. Clair Thomson and Mr. J. Y. W. MacAlister. The latter submitted a report in which he said:

The present movement was originated at a largely attended meeting held by invitation at Lord Eustace Percy's house, at which he urged that the opportunity presented by the coming together of medical men from America and all parts of the British Dominions should be utilized to organize some form of permanent organization which would result in a closer union between the English-speaking peoples through the medium of the medical profession. The proposal was warmly endorsed by those present, and Sir St. Clair Thomson and myself were asked to act as honorary secretaries and to endeavor to formulate a definite scheme and take the necessary steps for carrying it into effect.

I am afraid we have been able to do very little beyond sowing seed. A circular setting out our aims was prepared by Sir St. Clair Thomson, and circulated, in the first place, to the chiefs of the medical forces of this country, of the Dominions and of America, and from these very cordial expressions of approval and promises of support were obtained. The circular, backed by the opinions of those to whom we had first appealed, was then issued to a wider public, and many very gratifying and encouraging letters have been received. But practical progress depended as usual on the all-important question of finance, and in that direction we have no success to report. We had asked for and been promised an interview with the Prime Minister and Mr. Bonar Law in the hope of persuading the government to make a grant, but (one dare not say "unfortunately") the armistice intervened, and since then it would have been futile, if not impertinent, to trouble the Prime Minister with our affairs, and so, as far as finance is concerned, we have no progress to report. We have received letters which encourage us to believe that if a definite and approved scheme is prepared we may be able to get financial help from private persons.

After some discussion, in which the chairman, Sir Walter Fletcher, Sir St. Clair Thomson, Colonel Stock, Colonel Heald, Major Means, Colonel Castellani, Colonel Weinberg, Dr. Sorapure, Mr. MacAlister and others took

part, it was unanimously resolved to constitute the proposed organization with the object of drawing together the members of the medical profession in the inter-allied countries with a view to promoting intercourse and cooperation for the promotion of medical science and public health.

A general committee was nominated, and Sir Arbuthnot Lane was appointed honorary treasurer, and Sir St. Clair Thomson, Mr. Douglas Harmer and Mr. J. Y. W. MacAlister honorary secretaries (*pro tem.*).

THE PRODUCTION OF QUICKSILVER IN 1918

THE domestic output of quicksilver in 1918, according to statistics compiled by F. L. Ransome, of the United States Geological Survey, Department of the Interior, was 33,432 flasks of 75 pounds each, valued at the average quoted market price at San Francisco ($117.92 a flask) at about $3,942,301. Compared with the output of 1917 of 36,159 flasks, valued at $3,808,266, this shows a decrease in quantity of 2,727 flasks but an increase in value of $134,035.

The productive states were California, Texas, Nevada, Oregon and Idaho, named in the order of decreasing importance.

The production of California was 23,231 flasks, against 23,938 flasks in 1917, a decrease of 707 flasks. As usual of late years, the New Idria mine, with which is included the San Carlos mine, yielded nearly half of the total output of the state. Only one other mine in the state, the New Almaden (including the El Senador mine), produced over 2,000 flasks in 1918. New Almaden has produced to date about 1,124,100 flasks and in 1865 alone produced 48,138 flasks from ore that yielded 11.3 per cent. of quicksilver. In total production New Idria, with 315,434 flasks to the end of 1918, ranks second, and Oat Hill (Napa Consolidated), with about 140,000 flasks, comes third. Sulphur Bank nearly trebled its output of the previous year and probably would have made still larger gains were it not for the fact that the high sulphur content of the ore renders furnace treatment and condensation difficult.

In general, quicksilver mining in California maintained fairly well during the year the revival of activity due to the war, as indicated by comparison of the output (33,432 flasks) with the production of 11,303 flasks in 1914. A large number of mines that were formerly productive have remained idle, however, and with the gradual return to normal conditions other mines are likely to revert to this class.

The output of quicksilver in Texas was 8,475 flasks, against 10,791 flasks in 1917. The Ellis mine, near McKinney Springs, considerably increased its output, and the Mariposa mine also made a small gain. The output of the Chisos mine, however, declined, and that of the Big Bend showed a still larger falling off. The Big Bend has been nearly exhausted down to the level of the underground water, so that pumping and additional development will be necessary if any considerable output is to be maintained. Prospecting has been continued by the Rainbow Mining Co., on the westward continuation of the Chisos ore zone, and some ore is reported to have been found.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM N. LOGAN, professor of economic geology in Indiana University, was appointed state geologist by Governor Goodrich on January 1.

PROFESSOR NELLIS B. FOSTER, now lieutenant-colonel in the Medical Corps of the United States Army, has presented his resignation as professor of medicine and dean of the school of medicine of the University of Michigan, as he expects to be detailed to the military service for an indefinite period.

DR. A. HOYT TAYLOR, professor of physics at the University of North Dakota, now a lieutenant commander in the Navy, has resigned after a year's leave of absence and will continue his work at the Bureau of Standards on naval radio communication.

MAJOR LAWRENCE MARTIN, general staff, U. S. Army, on leave of absence as associate professor of physiography and geography in the

University of Wisconsin, who is chief, Geographical Section, Military Intelligence Division, General Staff, was sent abroad last July as military observer in France and Italy and served at the front with American, British, French and Italian troops. He is now on duty in Paris with the American Commission to Negotiate Peace.

E. B. BABCOCK, professor of genetics in the college of agriculture, University of California, has gone to France under the auspices of the United War Work Council of the Y. M. C. A. to help carry out the program for the vocational education of American soldiers.

DANIEL H. OTIS, assistant dean of agriculture in the University of Wisconsin, has received from the government an appointment as farm management specialist in France.

DR. J. F. ABBOTT, professor of zoology at Washington University, has been appointed commercial attaché to the American Embassy at Tokyo and will leave for Japan in February.

PROFESSOR J. C. MERRIAM, of the National Research Council, returned to his work in paleontology at the University of California after attending the Baltimore meetings.

PROFESSOR DAVID MORRILL FOLSOM has resigned from the chair of mining at Stanford University.

PROFESSOR JOJI SAKURAI, director of the newly established Institute of Physical and Chemical Research in Tokyo, Japan, has been visiting scientific institutions in the United States.

MR. DAVID BRUCE, of London, has been elected a corresponding member of the Paris Academy of Sciences in the section of medicine and surgery.

MAJOR F. E. BREITHUT, Chemical Welfare Service, has been detailed by the War Department to the War Trade Board to act as chairman of the chemical group of the price section. Associated with Major Breithut will be: Mr. F. W. Cassebeer, Captain P. W. Carleton, Lieutenant Chas. L. Fry, Lieutenant W. N. Jones, Dr. H. L. Lewenberg, Captain W. Lee Lewis, Dr. W. B. Meldrum, Captain H. L. Trumbull. This group of workers is engaged in a study of price fluctuation of chemicals during the war and an analysis of its cause and consequence.

FAYETTE S. CURTIS, chief engineer of the New York, New Haven & Hartford Railroad, was elected president of the American Society of Civil Engineers for the year 1919 at the sixty-sixth annual meeting, which opened in New York City on January 15. The other officers of the society elected are: Herbert S. Crocker, Denver, Col., and Leonard Metcalf, Boston, Mass., vice-president; Arthur S. Tuttle New York, treasurer; George H. Clarke and Jacob S. Langthorn, New York; Charles C. Elwell, New Haven, Conn.; Willard Beahan, Cleveland, O.; John W. Alvord, Chicago, Ill., and Carl E. Grunsky, San Francisco, Cal., directors.

AT the annual meeting of the Brooklyn Entomological Society held on January 16, the following officers were elected for 1919: *President,* Mr. W. T. Bather; *Vice-president,* Mr. W. T. Davis; *Treasurer,* Mr. C. E. Olsen; *Recording Secretary,* Dr. J. Bequaert; *Corresponding Secretary,* Mr. J. R. de la Torre Bueno; *Librarian,* Mr. A. C. Weeks; *Curator,* Mr. George Frank; *Publication Committee,* Messrs. J. R. de la Torre Bueno, Chas. Schaeffer and George P. Engelhardt.

PROFESSOR WILLIAM J. HALE, of the department of chemistry, of the University of Michigan, tendered his resignation to the regents at the December meeting of the board. Professor Hale has accepted a position with the Dow Chemical Company, at Midland, Mich., and will devote his entire time to research work.

DR. S. L. GALPIN, who for several years has been a member of the department of geology and mining engineering at Iowa State College is now engaged in development work in the oil fields of Oklahoma, Kansas and Texas.

MR. HENRY HINDS has resigned from the Geological Survey to enter the employ of the Sinclair Oil and Gas Company, at Tulsa, Oklahoma.

D. D. BEROLZHEIMER, formerly librarian of the American Chemical Society, and of The Chemists' Club, is now assistant technical

editor with The Chemical Catalogue Company, New York.

Announcement is made at the Smithsonian Institution of the appointment of Neil M. Judd of the department of anthropology as curator of American archeology, United States National Museum. Mr. Judd has been a member of the scientific staff of the Smithsonian Institution for eight years. He returned to Washington on January 1, after eleven months' service in the aviation section of the army.

In January Professor H. Austin Aikins, of Western Reserve University, gave two lectures at the Carnegie Institute of Technology, Pittsburgh, before the occupational therapy class on problems of psychotherapy and the work in Canadian hospitals of importance for occupational aids. Lieutenant Colonel E. K. Strong spoke on job analysis in the army before the Research Bureau for Retail Training at the Carnegie Institute of Technology on January 22.

Rolla C. Carpenter, professor of experimental engineering at Cornell University since 1890, died at his home on January 19. Professor Carpenter, who was born in Orion, Mich., 1852, had active charge of many large engineering projects, and was the author of important works on engineering.

The death from influenza is announced of Edwin Henry Ingersoll, chemist in the Bureau of Animal Industry, U. S. Department of Agriculture.

Professor R. Nietzki, professor of chemistry at Bâle, known for his work on the chemistry of dyestuffs, has died at the age of seventy-one years.

At a meeting of the bureau chiefs and other high officials of the U. S. Department of Agriculture, December 11, 1918, held to take action on the death of L. W. Page, Dr. L. O. Howard said: "During the forty years of my daily association with the workers of the department, I have seen many changes. Many men of different types have been here. Many have come and many have gone. Some of the best of us are still here. Some of the very best of us have gone—some to other fields of work, some to the Unknown. Among them all I think that Logan Waller Page, looking at his individuality as a whole, was unique. Absolutely unspoiled by his wealth, his culture, his family connections, his social position, gaining from his Harvard education all that was good and nothing that was bad; frank, straight forward, honest, despising sham and pretense, hating graft, highly trained, idealistic in a way but with a clear, cool brain, full of great plans and with the ability to make them practical; unselfish, working intensely for the good of the whole country, dedicating to the good of all ideas which might have been turned to his own personal profit, a wonderful mixer, meeting every man on his own level, a marvellous teller of apt anecdotes; a citizen of the world and the highest type of good American—no other single one of us has approached him and I am sure that no one of us will ever meet just his like again."

In the article by Willard J. Fisher, entitled "The Balance, the Steelyard and the Concept of Force," in Science for November 1, 1918, "the words animism and animists, wherever used, should be replaced by "animatism" and "animatists." For the distinction between these reference may be made to the Encyclopædia Britannica, from which the definition in the article was drawn."

The secretary general of the Nineteenth International Congress of Americanists has on inquiry received information from the Brazilian Embassy at Washington regarding the coming session of the Americanists at Rio De Janeiro, to the effect that, according to a cable received from the Foreign Office of Brazil, the Twentieth International Congress of Americanists will be held from the eighteenth to the thirtieth of June, 1919. In view of the above decision, and in consideration of the importance from many standpoints of the congress in Brazil, it seems advisable that due steps be taken without delay by the Americanists in this country and Canada for a good representation.

IT is stated in *Nature* that the annual meeting of the Association of Public School Science Masters was held at the London Day Training College on December 31, 1918, and January 1, 1919, under the presidency of Sir Ronald Ross. The subject of the president's address was "Observations on the results of our system of education." A lecture on poison-gas warfare was given by Lieutenant-Colonel Smithells. There were discussions on the impartance of restricting specialization in university scholarship examinations and giving weight to general education, opened by Mr. F. S. Young; science in the general education of boys, opened by Mr. W. D. Eggar and Mr. C. V. G. Civil; and courses in general science for classical Sixth Forms, opened by the Rev. S. A. McDowall.

UNIVERSITY AND EDUCATIONAL NEWS

GIFTS aggregating $128,000 to Yale University were announced on January 23. They include $25,000 to the Forestry School from Mr. and Mrs. Gifford Pinchot.

THE zoology department of Wabash College, of which Professor A. Richards has charge, has received from the estate of Professor Donaldson Bodine, formerly professor of zoology the sum of $5,000, to provide for the purchase of books for the zoology department, subject to an annuity.

AT the request of Professor Bailey Willis, professor of geology at Stanford University, who is continuing his war work with the House Commission in New York, Professor James Perrin Smith will act as executive head of the department of geology and mining for the coming year. Dr. Eliot Blackwelder, of the University of Illinois, has been appointed acting professor of geology during the winter quarter.

MR. H. P. STUCKEY, for the past ten years horticulturist at the Georgia Experiment Station, has been appointed director, to succeed J. D. Price, who resigned to accept the position on the Railroad Commission to which he was elected. Other changes in the station staff are the appointment of Mr. T. E. Keitt, formerly chemist of the South Carolina Station, as chemist the appointment of Mr. H. E. Shiver, formerly assistant in chemistry at the South Carolina Station as assistant chemist; the appointment of J. A. McClintock, formerly extension pathologist for Georgia, as plant pathologist and botanist, and the resignation of Mr. J. C. Temple, bacteriologist.

DR. N. L. BOWEN, of the Geophysical Laboratory, Carnegie Institution, has been appointed to the professorship of mineralogy at Queen's University, Kingston, Ontario.

DISCUSSION AND CORRESPONDENCE

AN UNCOMMON ICE FORMATION

WHILE skating on the upper part of the Charles River at North Bellingham, Mass., January 13, 1918, during a severe cold spell, we encountered an ice formation of a kind wholly new to us, though we have practised river skating for many years and are both fairly observant of natural phenomena. There is a low dam here over which a good head of water was flowing. Just below the dam an uneven bridge of ice resting partly on rocks and partly on the water formed a hood over the stream, and out of this rose a considerable number of upright columns of ice superficially somewhat resembling stalagmites. They were of pretty uniform diameter, about four or five inches, and varied in height from two or three inches to as many feet, while the tallest was perhaps three and a half feet. This tallest one and a number of the others were completed, being finished off with a tapering cap of snow-like structure that curved over towards the dam and into the wind, which was blowing pretty strongly down stream. Many, however, in process of formation showed how they were made.

They were all tubular and were built up from the inside by the bursting of bubbles that rose through the tubes and the freezing of the resulting spray. It was evident that the rush of water over the dam carried air with it under the hood of ice below, and that this air found vent here and there in the form of bubbles, which, bursting, gradually built up these vertical columns. Each unfinished, or live, column showed a crown of bursting

bubbles. The formation of the caps that finished off the completed, or dead, columns is, perhaps, to be explained in this way: When the column rose to a point where the wind reached it above the lee of the dam, the spray from the bursting bubbles would lodge chiefly on the leeward, or downstream, side of the orifice and in freezing would build up that side faster than the upstream side. The top would thus curve over upstream, the freezing spray building not only upwards but back against the wind, just as the hoar-frost or frozen mist of mountain-tops builds against a high wind. This would, of course, close the orifice in time and put a stop to the growth of the column.

It is not entirely clear how the bubbles rise to so considerable a height in the tubes—whether they are forced up by the rush of water over the dam and under the hood of ice, or whether it is because the air they contain is heated by the water to a higher temperature than the surrounding air. On this point, as on the whole subject, we should be very glad to get the opinions and observations of any one else who has seen this formation. Inquiry among friends has failed as yet to bring to light any similar observations on the part of others, and we find no mention of this phenomenon in the fourteen volumes of Thoreau's "Journal," observant as he was of the forms taken by ice, snow and frost along the Concord River and its tributaries. This has made our observation seem worth recording, though we can not doubt that under similar circumstances it might be repeated any cold winter.

Frederick A. Lovejoy,
Francis H. Allen
West Roxbury, Mass.

CELLULOID LANTERN SLIDES

To the Editor of Science: In a recent letter to Science regarding celluloid lantern slides, Mr. A. W. Gray states that "tracing cloth and waxed paper are usable; although their limited transparency produces a rather dark field, and the texture of the material shows plainly." The writer experimented some time ago with substitutes for glass lantern slides, giving special attention to slides which could be prepared quickly for temporary use.

I found that a satisfactory slide could be made by drawing figures or diagrams on thin white paper with india or colored ink. After the ink had become thoroughly dry both sides of the paper were brushed over with a light-colored penetrating oil. The thin glazed white paper used for duplicating typewritten letters serves admirably for the paper and a light neatsfoot makes a satisfactory oil. These paper slides may be inserted in cardboard holders and with suitable projecting apparatus the results are all that could be desired.

The effect of the oil is to increase greatly the transparency of the paper and when new the texture of the paper is quite imperceptible. Figures of lesser sharpness can be made with a fountain pen or even with a pencil. Diagrams and pictures of appropriate size may be cut from magazines or bulletins and treated with oil as outlined above. These are more satisfactory, of course, if no printing appears on the back, but for temporary use the printing in many cases will not destroy the usefulness of a diagram.

I have also made good slides in the same manner by treating $3\frac{1}{4} \times 4\frac{1}{4}$ photographic prints with oil. The projected pictures, while less bright than those procured with glass plates, present a softer effect and are especially interesting in the case of portraits. Since the usual photographic paper is quite heavy the lantern must be placed nearer the screen but if thinner paper could be obtained the results would be quite satisfactory if the usual distance were maintained.

Ralph G. Hudson
Department of Physics,
Kenyon College

HOLDING LARGE SPECIMENS FOR DISSECTION

In the zoological laboratory there are many things which are valuable aids in time and convenience. In dissecting large specimens it is often necessary to have some method of holding parts of the anatomy away so as to allow freer rein to one's actions, or of holding

the specimens open firmly. This may be done by using trays of galvanized iron with four or more loops of metal soldered on the sides to which ordinary heavy rubber bands are attached. To these rubber bands are tied small fishhooks which have had their barbs filed off. These hooks are to be fastened to any part of the anatomy so as to hold the specimen firmly, or to pull certain parts to the desired position. If a plain tray without the side loops is used, the rubber bands may be fastened to the ends of strong strips of cloth. The cloth is placed under the tray, one piece at the top and the other at the bottom, and if the strips are of the proper length, the rubber bands and hooks will be in relatively the same position as when they are fastened to rings along the edge of the pans. Removing the barb allows the hook to be withdrawn at any time without injuring the specimen. Care should be used not to stick the hooks in the hand, for owing to the strength of the rubber bands, the hook would make an ugly wound should it slip.

The advantages of this method are the saving of time and the lack of trouble, for we have a self-adjusting holder, as the rubber band allows for any change to be made in the position of the specimen or any of its parts. As compared to the old methods, it neither incurs the expense and the time of adjusting, as is the case with chains and hooks, nor the unreliability and unsteadiness as in the case where string and bent pins are used for this purpose.

JOHN M. LONG
WASHBURN COLLEGE

SCIENTIFIC BOOKS

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 9, pp. iii + 362, 105 pls., 14 figs., 1918.

In this handsome and very important volume there is a great deal of information that is of the highest value to the biologist, geologist, paleontologist and oceanographer. In fact, there is so much of value that this notice can mention but a few of the results that are most interesting to the reviewer. There are eleven papers, of which the largest is by T. W. Vaughan on "Some Shoal- water Corals from Murray Island (Australia), Cocos-Keeling Islands, and Fanning Island" (185 pp. and 73 pls.). The other authors are Alfred G. Mayer, M. I. Goldman, Albert Mann, Joseph A. Cushman, M. A. Howe, R. B. Dole and A. A. Chambers, R. C. Wells and L. R. Cary.

The shoal-water corals of the Great Barrier Reef of Australia described by Vaughan in the systematic part of his paper, amount to 149 forms and 38 genera, 1 genus and 15 species being new. Certain species range from the east coast of Africa on the west to the Hawaiian and Fanning islands on the east. Great pains have been taken not only to determine the proper names, but to give ecologic conditions as well. The illustrations are the finest we have ever seen of the skeleton of corals, and as the photographs are not retouched, the heliotypes look as natural as the corals themselves. Many of Dana's types are figured.

The ecology of the Murray Island corals near the northern end of the Great Barrier Reef is described at length in the first paper by Mayer, which is a very important one.

More than forty species were studied, with a view to determine the factors of their distribution. These factors, in the order of their importance, are: temperature, silt, the effects of moving water, and the struggle for existence between the species. All corals appear to be wholly carnivorous. Whenever the water is agitated, cool and free from silt, the reef-flat is wide and covered with an abundance of living corals, but where the water is calm, hot and depositing silt faster than the corals can remove it from themselves, the reef-flat is narrow and the corals deficient. Much silt kills corals in about two days. In a square 50 feet on a side, there occurred two living corals from 375 to 425 feet from shore, while in the same area, at from 1,400 to 1,500 feet out from land, there were 1,833 heads. Four genera constitute 91 per cent. of the corals present.

In regard to annual rate of growth among the stony corals there are some interesting facts. Some of the identical coral heads of

Thursday Island measured and photographed by Saville-Kent were remeasured by Mayer twenty-three years later. These results show that large coral heads may increase as much as two inches in diameter per year, while some kinds do not grow beyond a certain specific size. The average annual growth appears to be about one inch, though in the Floridian reefs the rate of increase is less.

Mayer states that stream waters pouring outward from forested volcanic shores are alkaline and thus can not dissolve limestone by reason of their "acidity." Thus the Murray-Agassiz solution theory of the formation of atolls is not supported. Holothurians are a potent factor in dissolving the materials that go to make reef limestones, which they swallow, and the effects of currents in scouring are important factors tending to convert fringing reefs into barrier reefs.

The problem of the precipitation of $CaCO_3$ in the ocean and the possibility of its solution there is discussed in the light of the latest evidence, and the conclusion is reached that in the shoal waters of the tropics, ocean-water does not dissolve calcium carbonate, but that the contrary process—precipitation by both inorganic and organic (bacterial) agencies—is taking place. Conditions in the deep sea, and perhaps in the cold waters of high latitudes, are different.

In the Murray Island reef sediments, Vaughan states that the dominant rock makers are (1) corals (34 to 42 per cent.); (2) coralline algæ (32 to 42 per cent.); (3) molluscs (10 to 15 per cent.); foraminifers (4 to 12 per cent.) and alcyonarians. Other marine animals are unimportant in their skeletal additions.

Cary shows that, in the Tortugas area, the gorgonians are also very important reef builders and therefore great rock contributors, since nearly 20 to 36 per cent. of their bodies consists of calcareous spicules. As almost all of these colonies die a violent death, and on the average all those living within 30 feet of water are replaced in five years by other colonies, he calculates that at least one ton of spicules or limestone is added per year to each acre of reef ground. In fact, when the gorgonians are common, they are more important as limestone makers than are even the stony corals.

Charles Schuchert

SPECIAL ARTICLES

A METHOD OF DEMONSTRATING THE DIFFERENCE-TONES

If a Rayleigh inductometer bridge be connected up, and a telephone receiver A be in series with the alternating e.m.f., the demonstration of the difference-tone is an exceedingly simple matter. Let the bridge be balanced for a high frequency F', say about 2,500; this tone will therefore not reach the ears if the balancing receivers be of the double, head-strap variety. Now whistle a scale into the receiver A. Since the bridge is not balanced for the new frequency, the whistle "gets through" into the balancing receivers. But one also hears another tone which slides down as the whistle slides up the scale. If between the balancing receiver and the bridge a good amplifier be connected, then the balancing receiver may be a "loud-speaking receiver" (such as are now used for announcing trains in large stations, etc.) and the apparatus is suitable for class demonstration. The great advantage of this arrangement is that we are not confined to any two fundamentals, as in the case of forks.

The phenomenon is unquestionably slightly complicated by the action of one alternator on the other, but I had not the time to see to what extent the extra tone differs from $F'-F''$.

The writer offers the above as a lecture experiment in physics and psychology, being under the impression that it has not been reported before.

Paul F. Gaehr
Wells College,
Aurora, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORT OF THE TREASURER FOR 1918

In conformity with Article 15 of the constitution and by direction of the council, the treasurer has the honor to submit the following report for the period December 15, 1917, to December 16, 1918, both inclusive.

The total of cash receipts during the year is $7,747.27. Disbursements made in accordance with directions of the council amounted to $7,786.00. These include $4,000 for purchase of a like amount of United States Third and Fourth Liberty Loan Bonds of 1918 for the association and held as an investment.

The total amount of funds of the association consisting of cash, cost value of securities purchased, and appraised value of securities received from the Colburn estate is $116,605.45.

A detailed statement is appended.

ROBERT S. WOODWARD,
Treasurer

December 23, 1918

BALANCE SHEET

Assets

Investments:	
Securities (Exhibit A)	$112,777.50
Cash in banks	3,827.95
	$116,605.45

Liabilities

Funds:	
Life memberships, 343 at $50	$ 17,150.00
Jane M. Smith Fund	5,000.00
Colburn Fund	77,755.74
	99,905.74
Unexpended balance	16,699.71
	$116,605.45

CASH STATEMENT

Receipts

1917		
Dec. 15. Balance from last report		$ 3,866.68
Interest from securities	$5,254.80	
Interest from bank balance	92.47	
48 life commutations	2,400.00	$ 7,747.27
		$11,613.95

Disbursements

Investments:		
$2,000 U. S. Third Liberty Loan of 1918	$2,000.00	
$2,000 U. S. Fourth Liberty Loan of 1918	2,000.00	$ 4,000.00
Grants:		
William Tyler Olcott	$ 300.00	
A. E. Douglass	250.00	
Carl Eigenmann	500.00	
Edwin B. Frost	500.00	
R. A. Porter	200.00	
E. W. Sinnott	200.00	
O. F. Stafford	500.00	
Herman L. Fairchild	200.00	
S. D. Townley	250.00	$ 2,900.00
Interest on Life Memberships:		
4 members (Jane M. Smith Fund)	$ 200.00	
343 members ($17,150 at 4 per cent.)	686.00	$ 886.00
		$ 7,786.00
Cash in Banks:		
Fifth Avenue Bank of New York	$1,722.69	
U. S. Trust Company of New York	2,105.26	$ 3,827.95
		$11,613.95

(*Exhibit "A"*)

SCHEDULES OF SECURITIES

Securities Purchased

Par Value	Purchase Value	
$10,000 Chicago and Northwestern Railway Co. general mortgage 4 per cent. bonds, due 1987	$ 9,425.00	
10,000 Atchison, Topeka and Santa Fe Railway Co. general mortgage 4 per cent. bonds, due 1995	9,287.50	
10,000 Great Northern Railway Co. first and refunding mortgage 4.25 per cent. bonds, due 1961	10,050.00	
10,000 Pennsylvania Railroad Co. consolidated mortgage 4.5 per cent. bonds, due 1960	10,487.50	
10,000 Chicago, Burlington and Quincy Railroad Co. general mortgage 4 per cent. bond, due 1958	9,350.00	
10,000 Union Pacific Railroad Co. first mortgage 4 per cent. bonds, due 2008	9,012.50	
10,000 Northern Pacific Railway Co. prior lien railway and land grant 4 per cent. bonds, due 1997	9,187.50	
10,000 New York Central and Hudson River Railroad Co. 3.5 per cent. bonds, due 1997	8,237.50	
8,000 U. S. Second Liberty Loan Bonds	8,000.00	
2,000 U. S. Third Liberty Loan Bonds	2,000.00	
2,000 U. S. Fourth Liberty Loan Bonds	2,000.00	$ 87.037.50

Bonds from Colburn Estate

Par Value	Appraised Value
$20,000 Acker, Merrall and Condit Co. debenture 6 per cent. bonds	$13,600.00
7,000 Buffalo City Gas Co. first mortgage 5 per cent. bonds	1,540.00
8,000 Park and Tilford Co. sinking fund debenture 6 per cent. bonds.	6,400.00

42,000 Pittsburgh, Shawmut and Northern Railroad first mortgage 4 per cent. bonds, due February 1, 1952.....	4,200.00	$ 25,740.00
$169,000		$112,777.50

I certify that I have audited the accounts of the treasurer of the American Association for the Advancement of Science for the period December 15, 1917, to December 16, 1918; that the securities representing the investments of the association have been exhibited and verified; and that the income therefrom has been duly accounted for.

The financial statements accompanying the treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof.

HERBERT A. GILL,
Auditor

Dated December 23, 1918

L. O. HOWARD, PERMANENT SECRETARY, IN ACCOUNT WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

From November 1, 1917, to October 31, 1918

Dr.

To balance from last account..........		$ 6,739.26
To receipts from menbers:		
Annual dues, 1918.......	$32,809.00	
Annual dues, 1919.......	208.00	
Annual dues, previous yrs.	312.00	
Admission fees	715.00	
Associate fees	6.00	
Life membership fees....	1,247.00	$35,297.00
To other receipts:		
Sale of publications	47.50	
Miscellaneous receipts including treasurer's payment of SCIENCE subscriptions for life members, interest, foreign postage, sale of programs, etc.	1,700.73	$ 1,748.23
		$43,784.49

Cr.

By publications:		
Publishers SCIENCE	$23,007.48	
Preliminary announcement, circulars, forms, etc.	1,222.50	$24,229.98
By expenses Pittsburgh meeting:		
Sectional secretaries' commutations, accounts, etc.		896.98
By expenses Pacific Division.		950.00
By expenses Washington office:		
Salary, permanent sec'y...$	1,500.00	
Salary, assistant sec'y....	2,000.00	
Extra clerical help......	1,916.60	
Postage	1,266.24	
Express, telephone and telegrams	91.79	
Office equipment	375.30	
Stationery and forms....	556.15	$ 7,706.08
By miscellaneous expenses:		
To treasurer, life membership fees ....$	2,400.00	
To overpaid dues returned.	26.00	$ 2,426.00
		$36,209.04
By balance to new account..		7,575.45
		$43,784.49

The foregoing account has been examined and found correct, the expenditures being supported by proper vouchers. The balance of $7,575.45 is with the following Washington, D. C. banks:

American Security & Trust Co.........	$2,327.27
American National Bank of Washington.	3,243.28
American National Bank of Washington (Savings Department)	2,004.90
	$7,575.45

HERBERT A. GILL,
Auditor

WASHINGTON, D. C.
December 18, 1918

SECTION E—GEOLOGY AND GEOGRAPHY

SECTION E of the American Association for the Advancement of Science met this year in conjunction with the Geological Society of America and the Association of American Geographers in the Civil Engineering building of Johns Hopkins University, Baltimore, on December 27 and 28. Following the present agreement whereby the affiliated societies take charge of the program whenever they meet jointly with Section E, the section had no program of its own. The address of the retiring vice-president, Professor George H. Perkins, of the University of Vermont, upon the subject, "Vermont physiography," was delivered on the evening of December 28 at the annual dinner of the Geological Society of America held in the Southern Hotel. It will be published in SCIENCE. The papers of the general sessions will appear in the *Bulletin* of the Geological Society of America, Vol. 30, and in the *Annals* of the Association of American Geographers, Vol. 9.

Dr. C. K. Leith, of the University of Wisconsin, was elected vice-president of the association and chairman of Section E for the coming year; Dr. H. A. Buehler, state geologist of Missouri, member of the council; Dr. W. W. Atwood, of Harvard University, member of the Sectional Committee for five years, and Frank W. DeWolf, state geologist of Illinois, member of the general committee.

ROLLIN T. CHAMBERLIN,
Secretary

SECTION H—ANTHROPOLOGY AND PSYCHOLOGY

SECTION H, Anthropology and Psychology, of the American Association for the Advancement of Science, held three sessions at the Baltimore meeting December 26-28. The Thursday afternoon meeting was in conjunction with the American Anthropological Association at which there was an attendance of forty-five.

The Friday afternoon session was in conjunction with Section L and the American Psychological Association. The attendance was over one hundred and the Saturday morning session was in conjunction with the Psychological Association also, at which there was an even larger attendance.

At the regular business meeting the following were elected to office:

Vice-president and chairman of the Section—Professor R. M. Yerkes, University of Minnesota.

Member of Council—Professor J. B. Miner, Carnegie Institution of Technology.

Sectional Committee for 5 Years—Professor W. S. Hunter, University of Kansas.

Member of General Committee—Professor A. E. Jenks, University of Minnesota.

At the Thursday afternoon meeting, Colonel Fabio Frassetto, Royal Italian Embassy, presented a paper on the subject, "A unified blank of measurements to be used in recruiting in the allied countries. A plea for the unification of anthropological methods." Following the paper it was moved and carried that a committee of three anthropologists be appointed to consider the paper and recommend action. Chairman, Dr. Aleš Hrdlička announced later the following members of this special committee: Dr. Franz Boas, Dr. G. G. MacCurdy and Dr. Robert Bennett Bean.

At the Thursday meeting Professor J. C. Merriam outlined the present plans of the National Research Council for continuation of its organization. The following resolution was presented at that time and formally adopted at the business meeting of the Section, Friday afternoon: Resolved:

(*a*) That Section H heartily approves the plan of the National Research Council for bringing about a closer cooperation of related branches of science favoring research.

(*b*) That, however, it is the opinion of Section H that good results in this direction can only be expected if perfect autonomy and freedom of each branch of science represented is safeguarded in the proposed division.

(*c*) And that it is further the opinion of the Anthropologists of Section H here assembled that the direction of each division as proposed of the National Research Council should be vested, not in a single appointee, but in a board consisting of a representative of each branch of science embraced in the division, and these representatives shall be men whose selection is ratified by the principal associations and bodies of these branches of science.

Titles of papers presented at the three sessions are as follows:

THURSDAY, P.M.

Race in relation to disease: DR. FREDERICK L. HOFFMAN, Prudential Insurance Company.

A unified blank of measurements to be used in recruiting in the allied countries: A plea for the unification of anthropological methods: PROFESSOR FABIO FRASSETTO, Royal Italian Embassy.

The war museum and its place in the National Museum Group: PROFESSOR W. H. HOLMES, United States National Museum.

Post-bellum anthropological research in the United States: DR. J. W. FEWKES, Smithsonian Institution, Washington.

Race origin and history as factors in world politics: PROFESSOR J. C. MERRIAN, National Research Committee.

The effect of the war upon the American Child: RUTH MCINTIRE, National Child Labor Committee.

Anthropology and Americanization training: PROFESSOR A. E. JENKS, University of Minnesota.

Heights and weights of children under six; statistics secured by the Children's Bureau: DR. ROBERT M. WOODBURY, Children's Bureau, U. S. Department of Labor.

The war and the race: DR. A. HRDLIČKA, United States National Museum.

FRIDAY P.M.

Examinations of emotional fitness for warfare: PROFESSOR R. W. WOODWORTH, Columbia University.

Army trade tests: DR. BEARDSLEY RUML, Trade Test Division, War Department (Carnegie Institute of Technology).

Practical application of army trade tests: MAJOR J. W. HAYES, Trade Test Division, War Department (University of Chicago).

Army personnel work; Implications for education and industry: LIEUTENANT COLONEL W. V. BINGHAM, Personnel Branch, General Staff (Carnegie Institute of Technology).

Methods of mental testing used in the United States army: MAJOR LEWIS M. TERMAN, Division of Psychology, Surgeon General's Office (Stanford University).

Psychological service in army camps: MAJOR GEORGE F. ARPS, Division of Psychology, Surgeon General's Office (Ohio State University).

4:30 P.M.

Vice-presidential address: Scientific personnel work in the army: PROFESSOR E. L. THORNDIKE, Columbia University.

SATURDAY A.M.

The work of the Psychology Committee of the National Research Council and the Division of Psychology, Surgeon General's Office, during 1918: MAJOR ROBERT M. YERKES, Division of Psychology, Surgeon General's Office (University of Minnesota).

Results and values of psychological examining in the United States Army: DR. MABEL R. FERNALD, Division of Psychology, Surgeon General's Office (Laboratory of Social Hygiene).

The relation of intelligence to occupation as indicated by army data: DR. JAMES E. BRIDGES, Division of Psychology, Surgeon General's Office (Ohio State University).

Functions of psychology in rehabilitation of disabled soldiers: MAJOR B. T. BALDWIN, Division of Reconstruction, Surgeon General's Office (Iowa State University).

Official method of appointing and promoting officers in the army: COLONEL W. D. SCOTT, Personnel Branch, General Staff (Director of Bureau of Salesmanship Research, Carnegie Institute of Technology).

Psychological investigations in aviation: MAJOR KNIGHT DUNLAP, Lakeside Hospital, Cleveland, Ohio (Johns Hopkins University).

Speech reconstruction in soldiers: PROFESSOR W. B. SWIFT, Division of Medical Inspection and Physical Education, Cleveland Public Schools.

A program for mental engineering: LIEUTENANT COMMANDER RAYMOND DODGE, Navy Department (Wesleyan University).

E. K. STRONG, JR.,
Secretary

THE SOCIETY OF AMERICAN FORESTERS

THE annual meeting of the Society of American Foresters was held at Baltimore, December 27 and 28, in conjunction with the American Association for the Advancement of Science. The following papers were presented:

The effects of destructive lumbering on labor: PROFESSOR B. P. KIRKLAND.

The timber census in the northeastern states: PROFESSOR A. B. RECKNAGEL.

Marketing of timber from farm woodlands: F. W. BESLEY.

The lumber industry and its relation to the war program: PROFESSOR R. C. BRYANT.

Use of wood fuel as a war measure: W. D. CLARK.

War lumbering in Scotland—some suggestions for American forest policy: E. C. HIRST.

Some future possibilities in the forest industries: PROFESSOR F. F. MOON.

The structure and value of Parana pine forests of Brazil: H. N. WHITFORD.

Forest formations in British Columbia: H. N. WHITFORD.

Forest research and war: E. H. CLAPP.

Preliminary results of forest experiments in Pennsylvania: PROFESSOR J. S. ILLICK.

Some aspects of silvical investigations as an after-the-war activity: CLYDE LEAVITT.

Factors controlling the distribution of forest trees in Arizona: G. A. PEARSON.

Gray birch and white pine reproduction: PROFESSOR J. W. TOUMEY.

Report of the war committee: PROFESSOR J. W. TOUMEY.

The officers of the society elected for 1919 are as follows:

President—F. E. OLMSTED.
Vice-president—W. W. ASHE.
Secretary—PAUL D. KELLETER.
Treasurer—A. F. HAWES.

PAUL D. KELLETER,
Secretary

SCIENCE

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SCIENCE

FRIDAY, FEBRUARY 7, 1919

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

VARIABLE STARS[1]

THE speaker before such a gathering as this, in this eventful year, faces a dilemma in his choice of a subject. The topic which is foremost in all our minds is, beyond a doubt, the share which our comrades in science have had in carrying to a triumphant close the great work of the war—and an account of this would in some respects be the most suitable subject for a vice-president's address. But most of this work can not be described yet, if at all, for reasons of military secrecy; and it is still too early, in any event, to collect and correlate the records of the work of men who are still in the service, especially when almost the whole of the narrator's time has been spent in attempting, in a very humble way, to aid in the universal effort.

I have therefore chosen the opposite horn of the dilemma, and propose to speak to you to-day upon a topic of pure science—removed perhaps as far as anything could be from the theater of war, trusting to whatever intrinsic interest the subject may possess to atone for the lack of timely interest, and the defects incident to hurried preparation.

Variable Stars have been the objects of human wonder since the appearance of the Nova of Hipparchus led to the preparation of the first catalogue of the positions and magnitudes of the stars. The period of scientific observation of these changes may be dated from Tycho Brahe's observations of the Nova of 1572 and Fabritius' discovery of the periodic variation of *Mira Ceti* in 1596.

For two and a half centuries after this date the number of known variables remained so small that they could almost have been

[1] Address of the vice-president and retiring chairman of Section A—Astronomy—of the American Association for the Advancement of Science, Baltimore, December 27, 1918.

counted on one's fingers. Since then the more assiduous observation of modern times has raised the number into the hundreds, and the application of mechanical methods of search (that is, of photography) has swelled our list into the thousands, with prospects of further increase.

It is now possible to classify almost all variables into fairly definite—often very definite—natural groups. In each of these groups more or less numerous empirical regularities of behavior, or "laws" have been detected; and in some instances the number of these relations is large, and the accuracy with which they represent the characteristics of individual stars is surprising. It has even been possible to use these relations to deduce information regarding the distribution of the stars in space, for example, which has revolutionized our previously existing ideas. Yet the humiliating admission must still be made that, in spite of these advances, we know extremely little of the real causes of stellar variation. A satisfactory theory exists in the case of but one group—and this is based on the fundamental assumption that the stars of this class are not really variable at all, but owe their apparent changes to the geometrical accident of eclipse! Of the causes, mechanism and physical relations of the intrinsic variability of the stars we are still in dense ignorance. Could we solve the riddle, there is good reason to hope that the key to some of the fundamental problems of astrophysics would be found.

In the study of variable stars, therefore, we have a series of problems which are at once laborious, difficult, fascinating and of great promise, and a summary survey of the field may afford very appropriate material for this address—considering first the methods of observation, and then the known facts, together with such theoretical conclusions as may be drawn from them.

From the observational side, the study of variable stars affords excellent examples of the advantages of "scientific management" and of cooperation. Until about a generation ago, the discovery of variables was made by accident, in the course of other work—such as the making of meridian catalogues or star charts, or the search for asteroids,—and the rate of discovery was naturally small. The great superiority of photography for this purpose was first effectively realized by Pickering and his assistants at Harvard. By superposition of a positive of a given star-field upon a negative of the same field taken at some other date any variables which may be present can be picked out at once. More than a thousand variables have been discovered at Harvard in this way—a number far exceeding the total which all the astronomers of the world had found by visual means in the preceding three centuries. The process is so easy that Miss Leavitt and her associates when working up a new region, never trouble to identify the previously known variables, but simply rediscover them along with the rest. From the percentage of known variables which are missed (usually a small one) it is possible to estimate how many unknown ones have been passed over and await future discovery.

Similar photographic studies of globular clusters led to Bailey's important discovery of the presence of variables in them—the importance of which is only now being fully realized. Mention should also be made of the successful work of Max Wolf and others with the blink microscope.

Another fruitful method of discovery is by means of spectrum photographs with the objective prism. Certain types of spectra with bright lines are practically certain to belong to variable stars. Mrs. Fleming and Miss Cannon have thus discovered some two hundred variables of long period and about half of the known galactic novæ.

When however a variable star has been discovered, the observer's work has just begun. Its changes must be followed and their laws determined. In many cases the variations are found to be exceedingly regular, both in period and amplitude, so that a very precise mean light curve may be obtained. Such

stars may profitably be followed by photometric methods of precision, as in the visual observations of Wendell and of Dugan and his students, or by means of "physical photometers," such as the selenium cell, or the photo-electric apparatus, the last of which especially, in the hands of Stebbins and of Guthnick, has proved to be the most precise of all ways of measuring starlight.

When such high precision is not necessary, good results may be secured by Argelander's method of direct estimate of the brightness in comparison with neighboring stars of known magnitude—either directly with the telescope, as Luizet and Roberts have done with notable success, or upon photographs, as by Miss Leavitt at Harvard.

Here the great Harvard Library of photographs is a rich mine, worked to but a small fraction of its capacity for lack of miners. Estimates of the photographic brightness of a few stars discussed at Princeton, show that the probable error of a determination of brightness from a single plate is about ± 0.06 magnitudes. Material for thoroughly reliable light curves of all regular variables which are brighter than the eleventh magnitude at minimum already exists in this great collection, and it is urgently desirable that more workers should be provided to make it available.

Still higher accuracy can be obtained upon plates taken specially for photometric purposes, as has been shown by Plummer and his associates.

The majority of variable stars, however, are far from exactly regular; and, when successive maxima may differ in an unpredictable fashion by a whole magnitude, there is clearly little advantage in observing to hundredths.

There are hundreds of such stars, most of them observable with small telescopes over a good part at least of their range—and to follow them all would tax the resources of the regular observatories severely. In this field amateurs have been able to make what is probably their most noteworthy contribution in the whole range of present day scientific activity. The American Association of Variable Star Observers, and its older colleague, the Variable Star Section of the British Astronomical Association, have organized this amateur activity in a highly successful fashion, and observations of these previously rather neglected objects are pouring in at the rate of many thousands a year—affording material which will be of inestimable value in the future.

The observations of variable stars show that almost all of them fall into some one of five natural classes—to adopt the very convenient division devised at Harvard. In the order there used these are: I., *Temporary Stars,* or Novæ; II., *Variables of long period;* III., *Irregular variables;* IV., *Short period variables,* or *Cepheids,* including cluster variables; and V., *Eclipsing variables,* including the Agol and Beta Lyræ types.

Variables of the last two classes are strictly periodic, and notably regular in their changes; those of the first three classes are not. But before discussing the separate classes in detail, we may well consider some of the general properties of variable stars of all kinds.

First, it is noteworthy that, speaking at large, there is as wide a range in the spectral types of variable stars as in those of the stars as a whole. Every one of the principal spectral types, and almost every subdivision of these types, is represented among variables. It appears safe to conclude from this that reliability, *per se,* is not confined to any one particular stage of stellar evolution.

There is however a decided difference in this respect between the various classes of variables. Eclipsing variables, though mostly of classes A and B, are found as far down the sequence as class K. Cepheid variables are known through the whole range from B to M—that is, in all the principal spectral classes.

Irregular variables, on the other hand, are almost all of classes M and N—and therefore among the reddest of the stars.

Long period variables also belong, without exception, to these spectral classes, and the great majority of them to the subclass Md, showing bright hydrogen lines, at least when

near maximum. Spectra of this type are practically certain evidence of variability.

Finally the novæ are distinguished by very peculiar and characteristic spectra, which undergo equally characteristic variations as their light fades. A very few other stars which show spectra of similar character are also variable (η Carinæ and the nuclei of two variable nebulæ).

Our first generalization may therefore be stated in the form:

Regular periodic variability has apparently little connection with the evolutionary stage of a star's history, while variation of a roughly periodic or non-periodic type appears to be intimately associated with particular stages of development.

This is after all very much what might be expected, for regular variation keeping time accurately suggests a process regulated by gravitation or rotation, and hence not necessarily connected with any stage of evolution, while other forms of variation may well arise from the physical state of a star, and appear only at definite evolutionary stages.

A second general property of variable stars is that, with insignificant exceptions[2] they are objects of great luminosity, far exceeding the sun. The eclipsing variables, with a few exceptions, average more than fifty times as bright as the sun. The irregular variables, and the long-period variables at maximum, appear to be comparable in brightness with other naked eye stars of class M, and hence about a hundred times as bright as the sun. The Cepheids are among the brightest stars of which we know, ranging from 100 up to perhaps 10,000 times the sun's brightness. As for the Novæ, we know as yet but little, but that little indicates that, at maximum, they may be even brighter than the Cepheids.

In general, it appears certain that almost all variable stars are what Hertzsprung so felicitiously calls "giants." According to the theory which the speaker has had a share in advancing this would mean that variability, while not confined to any one stage of a star's evolution, is a characteristic of its early life—not the flickering of the dying flame of age, but the exuberance of extravagant youth.

Hertzsprung's suggestion that the very faint dwarf red stars, which, all agree, represent the last observable stages of stellar history, should be investigated for possible variability, deserves however more attention than it has so far apparently received.

With these preliminaries, let us turn to a rapid survey of the individual classes of variables. Here it will be convenient to reverse the Harvard order, and begin with the *eclipsing variables.*

Typical variation of this sort is immediately recognizable, since it consists in regular interruptions of otherwise almost constant brightness. This behavior suggested to Goodricke, more than a century and a quarter ago, that the obscurations of Algol were due to partial eclipses by a huge dark planet, revolving around the luminous star in the period of variation. As this hypothesis considerably antedated the discovery that true binary systems existed among the visual double stars, it was of striking originality, and it may fairly be claimed that the history of binary stars begins with Algol. Unfortunately, the very boldness of the hypothesis led to its neglect for a full century, until Pickering revived it, and Vogel's spectroscopic study of Algol gave it striking confirmation; and it is only within the last ten years that the study of eclipsing binaries has really come into its own as a branch of double-star astronomy coordinated with that of visual or spectroscopic systems.

The eclipse theory of the variation of stars of this type now stands on about as firm foundations as anything in modern astronomy, being confirmed (1) by the precise representation of numerous well observed light curves (the irregularities whose presence was previously suspected disappearing with improved methods of observation); (2) by the fact that every eclipsing variable which has so far been studied spectrographically proves to be a spectroscopic binary in which the

[2] A few eclipsing variables, and the stars in the nebula of Orion recently discussed by Shapley.

period and phase of the orbital motion, and the relative brightness of the secondary, are in agreement with the photometric data, and (3) by the success of the reverse process of photometric investigation of promising spectroscopic binaries, which have in many cases revealed variation of the eclipsing type, though of small amplitude, but with the theoretical period and phase. The fact that some spectroscopic binaries have proved not to be variable is a further confirmation of the theory (the orbital inclination being such that eclipses fail to happen).

The development by the speaker of simple methods for computing the orbital elements of these systems has extended our list so that, at present, owing mainly to Shapley's industry, orbits are available for about 100 eclipsing pairs—a sufficient number to allow of drawing conclusions by statistical methods. These stars show a strong concentration toward the galactic equator, and the majority of them have spectra of classes A and B, though there are a number of class F and a few of classes G and K. Their periods are usually less than ten days, though two are known with periods of about six and nine months, and several others with periods about a month.

When a more careful study is made of their variations it is found that in every case in which decisive observations have been made, the eclipsing companion is not a dark body, but a self-luminous star. The maximum difference in brightness between the components of a pair is about four magnitudes, which would not be considered very great in the case of a visual binary. The secondary minimum, due to the eclipse of the companion by the principal star, is almost always of observable depth, and has been found whenever properly looked for.

In most of the cases which have so far been studied, the faint companion is of greater diameter than the brighter primary; but it is very doubtful whether this represents the general rule among close binary systems, for pairs in which the fainter star is the smaller can at best show but a small range of variation, and few of them are likely to be discovered, especially as observers give the preference to the stars of large range of variation.

It appears however to be an invariable rule that the faint companion is always much *redder* than the primary—which is clear evidence that its faintness is due to lower temperature. This is confirmed by Miss Cannon's direct observation, that in U Cephei, a typical system of this class, the spectrum of the brighter star is of class A, while that of the much fainter one which totally eclipses it at minimum is of class K. Two stars separated by a space equal only to their diameters, and doubtless of common origin and equal age, may therefore differ as widely in spectral type as do Sirius and Arcturus.

These systems offer the only direct method at present available for finding the relation between the color index and surface brightness of a star. The investigation has so far been complicated by uncertainties regarding the color equation of both the visual and photographic observations of such faint objects. When this difficulty has been surmounted, as it soon should be, there is a good prospect of being able to determine the surface brightness of a star from its color index—which would clear the way for determining the linear diameters of all stars of known parallax, and the angular diameters of all the stars in the heavens.

Of no less importance is the information which eclipsing binaries alone can give about the densities of the stars. The numerous stars of this sort, and of spectra A and B, are remarkably similar in density, averaging about one sixth the density of the sun. The fewer pairs of spectra F, G and K show a much greater range of density—some being denser than any of the stars of the first type, while others are of very low density, in a few cases less than 1/100,000 of the sun's. There is also strong evidence that the large faint red components of the systems mentioned above are less massive, and hence much less dense, than the small, bright, primaries of "earlier" spectral type. The bearing of these facts on stellar evolution is obvious.

By combining this knowledge of the densi-

ties of these stars with estimates of their masses and surface brightness (which can be made with a fair degree of confidence), it is possible to estimate their parallaxes, and study their distribution in space. The results of Shapley and the speaker show that these stars are distributed through a region nearly symmetrical about the galactic plane. The great majority of them lie within two or three hundred parsecs of this plane, but they extend along the plane in all directions to a distance of at least 1,500 parsecs, with no sign that our observation has reached the limit.

The statement that the brightness of an eclipsing variable is constant in the intervals between eclipses is only approximately true. In many instances—notably in Beta Lyræ—there are definite maxima half way between the eclipses, indicating that the stars are elongated into ellipsoids by their mutual tidal influence. The amount of this ellipticity decreases rapidly for pairs in which the components are more widely separated, following very closely the law predicted theoretically by Sir George Darwin.

Again, there is often a "radiation effect" showing that the companion keeps the same face always toward the primary, and that this face, being heated by the later, is brighter than the opposite side of the secondary (as was observed by Dugan in RT Persei, and by Stebbins in Algol). In a few cases, when the observations are very precise, it has been possible to show, from the form of the light curve, that the disk of the principal star is not uniformly luminous, but is brighter at the center than at the limb, like that of the sun.

The theory of eclipsing variables is therefore now in a satisfactory state: but there is much which still remains to do. Dozens of stars are still to be observed, and the light curves of many more require more accurate determination. The important task of comparing the visual and photographic light-curves of the same stars is only just begun; and there is a wide field for the physical photometer among the recently discovered systems of small range. Theoretically, many problems of interest await solution, especially the explanation of the small but indubitable, and perplexingly complicated, changes in period which occur in most of the systems which have long been observed. If these changes can be definitely referred in some cases to motion of the line of apsides of the orbit, it should be possible to obtain information about the degree to which the central density of the stars in question exceeds their mean density—a matter about which we now know nothing. There are also curious discrepancies between the times of minima, as observed with light of different colors, which are very puzzling. Enough is already known, however, to furnish a direct observational proof that the velocities of light of different colors in empty space can not differ by more than a very few meters per second.

Spectrographic observation of all accessible eclipsing variables for radial velocity is urgently to be desired, for this affords the only known way of adding to the few cases in which we can determine the actual diameters of the stars. Such matters as the precise determination of spectral type, especially of the faint companions during total eclipses, and the study of absolute magnitudes by spectroscopic means also deserve attention.

The Cepheid variables, which come next in order in our survey, present one of the most attractive and difficult problems of present day astronomy. There are few other fields in which we know so many facts, and can explain so few. The mass of information is so extensive that it must be rather summarily presented. Observation shows that:

1. The Cepheids show a regular variation, For each star the period is constant, and the light curve repeats itself with remarkable regularity. (The small deviations from this rule suspected by Shapley and others, though doubtless real, are insignificant in comparison with the irregularities that occur among long-period variables).

2. The periods range from three hours to more than a hundred days, but show two well-marked maxima of frequency at about twelve

hours (the cluster variables) and seven days (the Cepheids proper). The two groups are almost separated, there being very few stars with periods about two days.

3. The range of variation is always small, very rarely over 1.5 magnitudes. Photometry of precision is revealing many cases of Cepheid variation of very small range, the most notable example being Polaris.

4. The variation is continuous, and the rise to maximum is usually much more rapid than the fall to minimum, while the maximum is usually more sharply accentuated than the minimum. There are a few exceptions to the last rule, and also a few stars in which the rise and fall of brightness are about equally rapid, but none in which the rise is decidedly slower than the fall. The light curve is usually smooth and flowing, and secondary maxima or minima are rare, though they appear to be authenticated in a few cases. The general form of the light curve (which greatly resembles that of the velocity curve of a spectroscopic binary) is characteristic, and makes it easy to identify variation of this type.

5. The photographic range of variation is always greater than the visual, the curves being similar in shape, but the photographic amplitude about 50 per cent. greater. These stars are therefore much redder at minimum than at maximum.

6. The spectra of the stars of period less than a day are almost all of class A, (β Cephei, with a period of 5^h is of class B), those of three or four days' period are of class F; of 10 days' period of class G; while those of longest period are of class K or M.

7. The spectral class of these stars varies with the light, being "earlier" at maximum and "later" at minimum. As measured by the hydrogen lines, the range of variation is nearly a whole spectral class on the Harvard scale: as measured by the metallic lines it is much less.

8. All these stars show variation of radial velocity, with the period of the light changes. The epoch of minimum radial velocity (most rapid approach) coincides closely with that of maximum light, and that of maximum radial velocity with minimum light—no exception having yet been found among some twenty stars.

9. The range in radial velocity is nearly proportional to that in visual magnitude, at the rate of about 47 km. for one magnitude. Hence the velocity curve can be roughly drawn when the light curve is known. The correspondence of the two, however, is not precise.

10. Most of the brighter of these stars belong to Miss Maury's *ac* class, *i. e.*, have spectral lines sharper than the average. According to Adams' recent criteria, the spectra of these stars indicate very high luminosity.

11. The Cepheids proper (of period greater than two days) show a strong concentration toward the galactic equator, and have very small proper motions which nevertheless show conspicuous evidence of the drift due to the sun's motion in space. Their peculiar velocities are small, about 10 km./sec.

12. Those variables of the "cluster type" which are found in the sky at large behave very differently, showing a small galactic concentration. In the few cases so far studied their proper motions are considerable, (though they are faint stars) and their peculiar velocities very large.

13. A large number of Cepheid variables occur in the Small Magellanic Cloud, and a very definite relation exists between their periods and photographic magnitudes, the stars of longer period being the brighter. As the stars in the Magellanic Cloud must all be at very similar distances, this indicates that the absolute magnitude of a Cepheid is a function of the period.

14. Among the numerous short period Cepheids in the globular clusters those in any-one cluster are of almost exactly the same median brightness—differing from cluster to cluster. It is therefore very probable that all "cluster variables" of period less than a day, are of the same mean absolute magnitude. The few Cepheids of long period which occur in globular clusters are considerably brighter.

15. From the parallactic motions of the Cepheid variables which occur in Boss's Pre-

liminary General Catalogue it appears that these stars, which have a mean period of about seven days, have a mean absolute magnitude of —2.3 on Kapteyn's scale. Roughly speaking, they average at maximum about 1,000 times as bright as the sun and at maximum about 500 times the sun's brightness.

By combining these data, Shapley, in a remarkable series of papers, has derived an empirical curve which gives the absolute magnitude of any Cepheid whose period is known. The cluster variables are of median absolute magnitude —0.2 and average about 100 times as bright as the sun. The Cepheids of longest periods, forty days and over, appear to be fully ten thousand times as bright as the sun. With the aid of these data he has shown that the Cepheids proper lie in a region only a few hundred parsecs thick, which extends along the galactic plane for several thousand parsecs in all directions, while the isolated variables of the cluster type spread out into space far on each side of this region. The same data have been fundamental in his determination of the distances and distribution in space of the globular clusters—which has revolutionized our conceptions of the extent of the universe, and of the relation of the naked eye stars to it, but would lead us too far from the theme of the present hour.

Our empirical knowledge of Cepheid variables is therefore both extensive and accurate, and has already led to astrophysical conclusions of far-reaching importance. But our understanding of the nature of the physical process which lies behind the variation of these stars lags far behind in the rear.

Some things seem fairly clear. The concomitant variations in brightness, color and spectrum indicate very strongly that the proximate cause of all three is a variation in the surface temperature of the star. The enormous magnitude and great rapidity of the changes (a cluster variable may increase its brightness by fifty times the sun's whole light in two hours, and lose all this again in six hours) make it probable that the changes in temperature must arise from some process by which heat energy is transformed periodically back and forth into some form of potential energy—the loss by radiation during one period being relatively insignificant. Finally, the regularity of the process indicates that the regulative force behind it is gravitational—the potential energy taking some from such as an expansion of the mass against gravity—and that the physical process involved is some form of gravitational oscillation of "pulsation" of the mass, probably involving the compressibility of the material as an essential factor.

There are various alternative hypotheses, some of them attractive, for example, that which assumes that we have to do with a rotating body, hotter and brighter on one side than the other. This explains the general character of the changes in light and spectrum, and their regularity; but a detailed analytical study of the problem shows that it is impossible for the rotation of a convex body, brighter in some parts than others, but with each portion of invariable brightness, to give rise to a light curve in which the rise is as rapid, compared with the fall, as in the case of many typical Cepheids, and all the cluster variables. Hence it appears certain that actual changes in the temperature and brightness of the surface of these stars must take place during each period. The variations in radial velocity are also very hard to explain on the rotation theory, which would give the wrong phase.

Another attractive hypothesis, which meets the difficulty about the radial velocities, assumes that the face of the star which precedes in the orbital motion is brighter than the hinder side, as would be very probable if the motion took place in a resisting medium. But this idea appears less alluring when it is realized that these stars, which are very similar to the sun in spectrum and color, and presumably in surface brightness, must in that case have radii of the order of 20 million kilometers, while the average radius of one of the spectroscopic orbits is less than two million kilometers. Hence the stars themselves are in all probability much larger than their orbits

(just as the radius of the earth exceeds that of the orbit which the earth's center describes about the center of gravity of the earth and moon). If, as is very probable, their periods of rotation and revolution are the same, the actual motion of one of these stars would closely resemble a rotation about an axis passing nearly, but not quite, through its center, and there would be no "leading side" in the sense assumed by the theory.

Moreover, the rotation of so large a body would give rise to an equatorial velocity so large as to make all the lines in the spectrum wide and diffuse; whereas they are actually narrower than in most stars.

It therefore appears improbable that these bodies are really spectroscopic *binaries,* and more likely that the line displacements arise in some other manner than from orbital motion.

A further argument against both these theories is that, if the direction of the rotation or orbital motion in any system should be reversed, the resulting variation would show a slow rise to maximum and a rapid fall—which has never been observed. If the variation arose from orbital motion the same effect would be produced by observing the star from any point on our line of sight, but behind it. That variations of this sort should be of equal geometrical probability to the others, and yet never be observed among a hundred cases, is altogether beyond reason.

Though these theories appear therefore to be unsatisfactory, it must be frankly admitted that the pulsation hypothesis is not yet in a position to explain positively the form of the light-curve or the apparent variations in radial velocity. So far, all that can be said for it is that it does not seem to fall foul of any obviously fatal difficulties, and that it appears likely to be fairly flexible.

A detailed mathematical study of the possible modes of vibration of a compressible, gravitating, radiating and possibly rotating mass of gas may lead to the solution of the problem. In spite of the evident difficulty of such a discusion it is to be hoped that it will soon be attempted—perhaps by the new and brilliant school of English mathematicians of which Eddington and Jeans are the leaders.

In the present state of our knowledge, the following admittedly speculative considerations may be of interest.

From Shapley's careful work it appears that, among the Cepheids proper, the absolute magnitude and color index are practically linear functions of the logarithm of the period. For a star of color index 0.75 (similar to the sun's) the period is 7 days, and the median absolute magnitude —2.3, corresponds to a luminosity 700 times that of the sun. It seems fairly safe to assume that the surface brightness of such a star is equal to that of the sun, so that its diameter may be estimated as 26 times the sun's.

Cepheids of longer periods are brighter and redder, the absolute magnitude decreasing (numerically) by $1^{m}.0$, and the color index increasing by $0^{m}.4$ if the period is doubled. This increase of color index indicates almost certainly a decrease of surface brightness. From the existing data, it sems probable that the change in surface brightness, expressed in stellar magnitudes is fully three times that in the color index. To obtain a total luminosity one magnitude greater, with a surface brightness 1.2 magnitudes less, the diameter must be increased 2.7 times. Hence it appears probable that a Cepheid of 14 days period is of about 70 times the sun's diameter, while one of 40 days' period (about the longest usually met with, of about twice the diameter of the earth's orbit—very large, it is true, but undoubtedly still of stellar and not of nebular dimensions.

A typical cluster variable 100 times as bright as the sun, and of color index 0.15, should be of about four times the sun's surface brightness, and four and a half times its diameter.

If now we adopt the pulsation hypothesis, it follows that, as in the case of all gravitational oscillations, the period will be inversely proportional to the square root of the density.

Hence doubling the period corresponds to a four-fold diminution of the density. But we

have just seen that it also gives with an increase in diameter by a factor of 2.7 or of volume by a factor of about 21. Hence it follows that Cepheids of any given period have about five times the mass of those of half the period. This conclusion (which holds good only for the Cepheids proper, and not at all for the cluster variables) depends to some degree upon the assumed relation betwen color index and surface brightness; but it is hard to see how any juggling with the data can escape from the conclusion that Cepheid variation sets in, if at all, at different stages of evolution among stars of different masses—the most massive stars reaching the critical condition, (whatever it may be) at the lowest density.

Among the cluster variables, which are very similar to one another in color and brightness, and hence probably in diameter, both density and mass must be greatest for the stars of shortest period. This reversal of the relationship may be connected with the fact noted by Shapley, that the absolute magnitude of these stars mark an inferior limit of luminosity, below which Cepheid variation appears not to occur.

To attempt a numerical estimate of the densities and masses of these stars is precarious, as we do not know the exact nature of the mode of pulsation. But the assumption seems plausible that for a star of given density, the period of the Cepheid pulsation is not likely to be very different from that of the fundamental oscillation of a gaseous mass of the same density. According to Emden, this period would be two hours for a mass of the density of the sun. This leads to the rough estimate that a Cepheid of 7 days period is of about 1/7,000 of the sun's density. With the diameter previously estimated this would mean a mass 2.7 times that of the sun. A Cepheid of 3½ days' period would have about half the sun's mass, and one of 40 days' period about 150 times the sun's mass. A cluster variable of 12 hours period would be of 1/36 the density, and 2½ times the mass of the sun.

These numerical values are extremely uncertain but it is of interest to note that they appear to be of quite a reasonable order of magnitude. The masses calculated for the Cepheids of moderate period, which are brilliant giant stars, are probably rather low—which suggests that the Cepheids of long period are really stars of exceptionally great mass, as would follow, on Eddington's recent theory, from their exceptionally great luminosity. Eddington has very recently called attention to another important deduction that may be drawn from the study of variables of this type. The period of Delta Cephei is shortening by about one second in twenty years. On the pulsation hypothesis, this would indicate a gradual increase of density, but at so slow a rate that it would take the star three million years to double in density, and probably ten million to pass from class G (its present type) to class F.

If studies of the secular variation in period of other Cepheids confirm this date of change, there will be direct evidence that the rate of stellar evolution is exceedingly slow and that the time scale of cosmical processes is of very great length.

But what time remains must be devoted to the other classes of variable stars. The *irregular variables* need detain us but for a moment, for, beyond the fact that their variations are usually of small amplitude, their spectra practically all of classes M or N, and their luminosities probably comparable with those of other giant stars of these types, we know practically nothing about them.

The variables of long period form a very definite natural class, with periods ranging from about 80 to 800 days, but exhibiting a nearly normal frequency distribution about a mean value of 300 days. The range of variation is much greater than for any other class of variables except the Novæ, averaging about four magnitudes, and sometimes reaching seven or eight—a change of a thousand-fold in light.

They are far from being regular time-keepers. For almost all the stars that have been carefully followed, the times of maxima deviate from any uniform period by much more

than the errors of observation. Attempts to represent these deviations by means of empirical formulæ have so far failed to meet the test of prediction, and it begins to look as if they were, in the strict sense of the word, irregular—though of the fundamental periodicity lying behind them there can be no doubt.

The maximum brightness, and the details of the form of the light curve, also differ very considerably at different times for the same star. The mean of a number of periods, however, usually gives a fairly smooth light-curve of roughly sinusoidal form, but with the rise usually steeper than the fall. Harmonic analyses of these curves have been made by Turner and Phillips, showing that the first harmonic largely predominates though the second and third are usually quite sensible. Phillips has shown that nearly all the stars so far investigated fall into one or other of two groups, marked by certain definite relations between the phases of the second and third harmonics. In other words the deviations of the light curve from a simple sinusoid tend to follow one or other of two definite patterns. This discovery will doubtless prove of theoretical importance, but no attempt to explain it can yet be made.

The above remarks apply to the curves obtained by plotting the stellar magnitude against the time. If the actual light-emission should be used instead, the curves would have high, steep-pointed maxima and very flat minima, and their representation by a Fourier series would demand a host of harmonics. The simple character of the curves giving the magnitude as a function of the time suggests, as Plummer has pointed out, that the periodic process involved may be something, such as variation in the thickness of an absorbing layer, which would directly affect the logarithm of the escaping light. But such a layer would have to absorb over 90 per cent. of the energy passing through it for months at a time without becoming greatly overheated, which seems, hard to believe.

The most notable spectroscopic features of these stars are the presence of heavy flutings of titanium oxide, indicating very low surface temperatures, and of bright hydrogen lines—which are especially strong near maximum; and, on the negative side, a conspicuous absence of changes in radial velocity.

The rather scanty data at present available indicate that the peculiar velocities of these stars are very high, and their proper motions moderate or small in amount. This would indicate considerable distance and luminosity, and it seems clear that, at maximum, these are fairly bright giant stars, at the least. Further data, especially regarding proper motions, are much to be desired, and should be obtainable in many cases.

Very little is known of the real causes of variation of this type. It is certainly not due to orbital motion, and the prevalent irregularities suggest strongly that we have here to do, not with a gravitational or rotational phenomenon, but with a physical process—something resembling in nature the eruptions of a geyser, when an accumulation of internal energy piles up to the point where it obtains relief through some overlying resistance, giving rise to roughly periodic outbursts of varying intensity. The relatively great length of the period falls in well with this hypothesis. There is much about the phenomena which suggests the variation in solar activity of which the sunspots are the most prominent symptoms. This is pretty certainly due to some such accumulation of internal strain and has the same irregularly periodic character, though a much longer period.

What the actual nature of the process is which can change the brightness of a star by several hundred fold remains, however, for the future to determine.

Mention should be made in passing of two curious types of variation, each represented by but few stars, but very definite, which are classified at Harvard as subdivisions of class II. The typical star of one of these groups. R Coronæ Borealis is usually of about the sixth magnitude, but at irregular intervals drops rapidly to the eighth, tenth, or even the thirteenth magnitude, recovering again after intervals which may be months or years in duration. Two or three other stars behave in

the same way. The other group, typified by U Geminorum and SS Cygni, are normally very faint, but at irregular intervals (of two or three months for the last named star) increase rapidly by some four magnitudes, to fade away again after a few days. It is a curiously suggestive fact that the stars of each of these singular classes are very similar to one another in spectrum, while the spectra of each class as a whole are quite unlike one another or anything else in the heavens. Here is indeed a riddle for the future to solve.

Finally, we come to the temporary stars—those most spectacular of all celestial objects. To discuss them fully would require another address comparable in length to this. The merest outline must suffice. Before the outburst, several of them are known to have existed as faint stars, often slightly variable. Without warning and within a very few days at most, their light increases at least a thousand fold—sometimes fully a hundred thousand times. The happy chance by which the recent great Nova in Aquila was caught midway in the rise indicates that its whole ascent occupied about two days. The maximum brightness is sometimes very great.—Tycho's star of 1572 equalled Venus—but a rapid decline sets in almost at once, followed by irregular oscillations with a general downward tendency, merging into a slower but steady decline, till within a decade or so the star has lost eight or ten magnitudes and returned nearly to its original brightness.

The spectroscopic changes are meanwhile of the most extraordinary character. The three stars which have been caught on the rise showed dark line spectra, roughly resembling familiar types, but no two alike, and with the lines greatly displaced, as if by a huge velocity of approach. As the star goes "over the top" its spectrum explodes, so to speak, in a few hours into a flamboyant affair of bright and dark lines, enormously widened and displaced, and undergoing continual changes. Lines of hydrogen, helium, and enhanced metallic lines have been recognized. Besides the bright hydrogen lines in Nova Aquilæ there were at times two sets of sharp dark lines—apparently due to hydrogen, but displaced by amounts corresponding to velocities of approach of about 1,800 and 2,600 km./sec. Complicated changes occur as the light fades, the most important being the appearance of the characteristic nebular lines, which at some stages are the most conspicuous feature of the spectrum, and remain visible for a long time. After some years, however, they begin to fade, and the last state so far recognized is spectroscopically identical with the Wolf-Rayet stars.

Novæ show a very strong galactic condensation. Nothing is known of their proper motions, or (for obvious reasons) of their peculiar velocities; but direct measures of parallax indicate that the distances of some of the brighter ones are of the order of at least 100 parsecs. They must therefore be exceedingly bright objects at maximum; but how bright we do not know.

These objects bear very remarkable relations to nebulæ. They appear to be related spectroscopically to the gaseous nebulæ. The unique moving nebula near Nova Persei was admirably explained by Kapteyn as due to the illumination of a sheet of diffuse matter, nearly at rest, by the outgoing light of the great outburst—a hypothesis confirmed by Slipher's recent discovery that two variable nebulæ appear to shine by reflected light from their nuclei, which show spectra very similar to novæ.

Most remarkable of all is the recent discovery that novæ appear in the spiral nebulæ so fast that it would take intensive observations to catch them all.

It is obvious that in these temporary stars we are in the presence of *catastrophes*, which in magnitude utterly transcend all other known physical phenomena. And these catastrophes are not of rare occurrence, but happen every few years, or oftener, in the galaxy, and apparently every few weeks in the Andromeda nebula. Two possibilities suggest themselves at once—a collision or an internal explosion. Collisions between two stars are quite out of the question—owing to the frequency and

short duration of the phenomena. The hypothesis of a collision between a star and a nebula meets these two fundamental objections, and appears capable of accounting qualitatively for many or most of the phenomena, as was shown some years ago by Seeliger. But the spectroscopic data, and especially the dark-line spectrum on the rise, remain difficult to explain. A collision between a star and a relatively small dark body—recently postulated by W. H. Pickering—is also worthy of consideration; but presents difficulties of its own.

After what we now know and believe regarding the stores of energy which are locked up in the nuclei of atoms, the hypothesis of an explosive release of some such form of energy within a star can not be neglected. The chief difficulty about it seems to be that we might expect an even greater catastrophe than appears to occur—but this theory will probably prove to be increasingly flexible as our knowledge advances. At present, however, the collision theory appears to the speaker the most promising. The great frequency of novæ in the spiral nebulæ—where we might expect collision to occur, if anywhere in the universe—seems to be favorable to this view.

In concluding this hasty and imperfect survey of a wide field, two things stand out prominently—first, the importance of a study, which was once neglected and even rather despised, in the attack upon some of the most fundamental problems of astrophysics, and, second, the urgent need of extensive and active researches, observational, statistical and theoretical, to advance toward solutions of some of the many unsolved problems which still remain before us.

Henry Norris Russell
Princeton University Observatory,

CHARLES ROCHESTER EASTMAN[1]

On this side of the Atlantic there have been few zoologists who have devoted their lives to the study of ancient fishes—which for the rest concerns not a few of the greatest problems of the vertebrates. Of investigators who have passed away we recall the distinguished names of Agassiz the elder, Cope, Newberry and Leidy, and to this goodly fellowship we must now add the name of Charles Rochester Eastman, whose services have contributed widely and intensively to a knowledge of fossil fishes. To this work he gave his time devotedly for a quarter of a century, publishing over a hundred papers, among them a number of monographs which rank among the most scholarly and accurate in their field.

Eastman graduated from Harvard in 1891, studied at Johns Hopkins, thereafter in the University of Munich, where he took his doctorate in 1894; he worked with Professor Karl von Zittel, whose laboratory then attracted a number of young American paleontologists. Here, as Eastman's interests already centered in fossil fishes, he was given the only material for research which the German university had at hand—a mass of detached teeth of a Chalk Measures shark—not attractive material, to say the least, but the young investigator attacked it with energy and soon gathered the data for a successful thesis. He was next given a post at Harvard, where in the Museum of Comparative Zoology, under the mantle of Louis Agassiz, he reviewed the collections of early fishes and found much material for publication. He now became interested in the Devonian fossils of the Agassiz collection, which he found shed light upon the rich finds from the Middle West, then being described by Dr. Newberry. Eastman's imagination was especially touched by the range and character of "placoderms" as the dominant group of Devonian times, and like many another worker, he set himself to solve the puzzles of their lines of evolution and of their kinship to modern fishes. Hence he sought actively for more extensive and better preserved material upon which to base his findings. The best collecting ground for these American forms was in Ohio, and throughout this region Eastman soon learned to know the fossil hunters and their collections. His studies upon these forms thereupon spread over wider fields, and became well-nigh encyclopædic; he brought the entire Devonian

[1] Born Cedar Rapids, Iowa, June 5, 1868, died Long Beach, N. Y., September 27, 1918.

fish fauna under his finger tips, literally: and if Eastman were sought for at this time, he would have been found at the top of the Agassiz Museum in the center of a labyrinth made up of tiers of great trays of fossils: and the visitor would come away with the impression that there was something almost uncanny in the skill with which Eastman could call up out of the mud-colored shales these primæval creatures, for their *membra disjuncta* would be made to fit in place so quickly, so faultlessly, and sometimes with so audible a click that one could almost picture the fish coming to life in its tray.

From the study of placoderms, Eastman's studies extended naturally to the contemporary lung-fishes and ganoids, and to our knowledge of these early forms he made numerous contributions. Now and again he would hark back to the group of sharks, trying ever to bring order into this primitive and difficult group. Port Jackson sharks, with their curiously modified dentition, which enabled them to crush the shells of shellfish, suggested new lines of evolutional changes, and his work on these forms from Illinois, Iowa, Missouri, Kansas and Nebraska showed new sequences and enabled him to fill out the gaps in their history. Certain of these early sharks became so similar to lung-fishes in their dentition, that, on this evidence alone, the two great groups of fishes might readily have been merged.

During the last decade of his work, Eastman's attention was drawn more closely to types of modern fishes. This was perhaps due to the fact that he had been able to bring to this country the famous collection of a Belgian paleontologist, de Bayet, and install it in the Carnegie Museum at Pittsburgh. Upon the fishes of this collection, especially those from northern Italy (Monte Bolca) he published a number of beautiful memoirs.

In matters relating to the phylogeny of fishes, Eastman was conservative. Thus, following Smith Woodward, he maintained that the group of placoderms which the latter defined as *Arthrodira* was definitely related to primitive lung-fishes: he had little sympathy with those who believed that they had solved the riddle of *Tremataspis* and *Bothriolepis* by associating with them arthropods. As a systematist, Eastman was thorough, and the forms which he described will rarely need revision.[2]

[2] Mrs. H. J. Volker has recently reviewed the papers of Dr. Eastman, and summarizes his systematic contributions as follows:

New families: (3)
Astraspidæ.
Peripristidæ.
Pholidophoridæ.

New genera: (12)
Belemnacanthus.
Campyloprion.
Eobothus.
Eolabroides.
Gillidia.
Histionotophorus.
Palæophichthys.
Parafundulus.
Parathrissops.
Phlyctænacanthus.
Protitanichthys.
Tamiobatis.

New species: (115)
Acanthodes beecheri; marshi.
Ameiurus primævus.
Amiopsis (?) dartoni.
Anguilla branchiostegalis.
Asterolepis clarkei.
Asthenocormus retrodorsalis.
Belemnacanthus giganteus.
Blochius moorheadi.
Bothriolepis coloradensis.
Campyloprion annectans.
Caranx primævus.
Carcharias collata; incidens.
Cestracion zitteli.
Chanoides leptostea.
Cladodus aculeata; prototypus; urbs-ludovici.
Cœlacanthus exiguus; welleri.
Cœlogaster analis.
Conchodus variabilis.
Ctenacanthus acutus; decussatus; longinodosus; lucasi; solidus; venustus.
Dicrenodus texanus.
Dinichthys dolichocephalus; livonicus; pelmensis; pustulosus; trautscholdi.
Diplodus priscus; striatus.
Diplomystus goodi.
Dipterus calvini; costatus; digitatus; mordax; pectinatus; uddeni.
Elonichthys disjunctus; perpennatus.
Eomyrus formosissimus; interspinalis.
Erismacanthus barbatus; formosus.
Fissodus dentatus.
Galeocerdo triqueter.
Glyptaspis abbreviata.
Gyracanthus primævus.
Harpacanthus procumbens.
Helodus comptus; incisus.
Histionotus reclinis.

No one can recall Dr. Eastman without bringing to mind his keen appreciation of ancient literature. He read the classical texts fluently, and Aristotle and Pliny had to him the interest of modern authors. Perhaps he knew them and their kindred better than did any living paleontologist. For bibliographical work Eastman had ever a distinct leaning, for to know what others had done in a definite field was the only honest beginning of any research. It was this interest which led him to accept the invitation of the American Museum of Natural History to undertake the editorship of a bibliography of fishes which the museum was engaged in publishing, and it was under his supervision that the two first volumes of this work appeared—ever to lighten the labors of workers in this field.

BASHFORD DEAN

Homacanthus acinaciformis; delicatulus.
Homœolepis suborbiculata.
Janassa maxima; unguicula.
Lepidotus ovatus; walcotti.
Machæracanthus longævus.
Macrosemius dorsalis.
Mene novæ-hispaniæ.
Myliobatis frangens.
Mylostoma newberryi.
Notagogus decoratus; minutus; ornatus.
Œonoscopus elongatus.
Onchus rectus.
Oracanthus triangularis.
Orodus intermedius.
Palæophichthys parvulus.
Parafundulus nevadensis.
Parathrissops furcatus.
Phlyctænacanthus telleri.
Phœbodus dens-neptuni; knightianus.
Pholidophorus americanus.
Phyllodus hipparionyx.
Physonemus hamus-piscatorius; pandatus.
Platinx intermedius.
Polyrhizodus grandis.
Priscacara dartoni.
Propterus conidens.
Protitanichthys fossatus.
Ptyctodus compressus; ferox; panderi; predator; punctatus.
Pygæus agassizii.
Rhadinichthys deani.
Rhynchodus major; pertenuis; rostratus.
Sagenodus cristatus; pertenuis.
Sauropsis curtus; depressus.
Squatina minor; occidentalis.
Stethacanthus erectus.
Streblodus angustus.
Synechodus clarkii.
Synthetodus calvini.
Tamiobatis vetustus.
Undina grandis.
Urosphen attenuata.

SCIENTIFIC EVENTS

THE FOREST SERVICE IN WAR TIMES

How the Forest Service met its war responsibilities is the main subject discussed by its chief, Henry S. Graves, in his annual report to Secretary Houston, just published. The war led, he asserts, to the temporary abandonment of many of the old lines of work, the curtailment of others, and the assumption of large new duties. Because of the close relation of the National Forests to the economic life of the country and to the production of necessities never before so urgently required, "their continued administration along lines which would prevent the breakdown of any essential industry was an obvious duty." At the same time the Forest Service was employing its technical knowledge and equipment for the furtherance of war preparations involving the use of forest products, in response to the many demands of the War and Navy Departments and the war industries.

There were furnished to the Army and Navy 446 men, while a considerable number left to serve in the War and Navy Departments in a civil capacity and to take part in industries directly concerned in producing materials for war uses. Still others were forced to leave the service because with the low standard of salaries, they were unable to meet the rising cost of living. All told, 1,179 persons had gone from the service prior to October 1. The situation of the Forest officers, clerks and others having fixed bases of salary is regarded by the forester as very critical, requiring the earnest consideration of Congress.

The receipts from the National Forests were slightly greater than in 1917, with a total of not quite $3,600,000. The grazing business produced an increase based on the land classification work, the area showed a slight net reduction, leaving the amount of government-owned land in the forests at the close of the year 155,927,568 acres.

Regarding the land classification the report says:

After nine years of steady sifting to separate from the forests such lands as should not be retained permanently in public ownership, the task

has, except in Alaska, been brought substantially to completion. The existing forests are approaching stability.

Hand in hand with the cutting down of the forests, a movement in the opposite direction has taken place, which has the same basic purposes—to provide for the highest use of the land; and this movement, the report states, is growing stronger. This is due primarily to the demonstration of the public advantages realized through government ownership and administration. A memorial of the state of Idaho is cited, asking Congress to include in the National Forests an area of over one million acres in that state which is now contributing little or nothing to the wealth of the state but is undergoing deterioration. This addition, says the report, should unquestionably be made.

The report deals fully with the numerous and important investigations made for the benefit of war activities. Practically the entire research organization was placed on special war investigations and was increased in size more than five times to meet the demand for information. Among the most urgent problems were those connected with the construction of aircraft, and a vast amount of information applicable in airplane construction was obtained.

Practically all the war work branches of the government having to do with the purchase of wood materials were added, including in the Army the General Staff, the Bureau of Aircraft Production, the Ordnance Department, the Signal Corps, the Quartermaster Department, the Engineer Corps the Gas Warfare Department and the Surgeon General's Office; in the Navy the Bureaus of Construction and Repair, Steam Engineering, Yards and Docks, and the Navy Yards; the Shipping Board; the Emergency Fleet Corporation; the Director General of Railroads; the War Industries Board; the War Trade Board, housing organizations; the Fuel Administration, and the Food Administration. In addition, cooperation and assistance was given the Allied Governments and to the industries furnishing war materials.

Mention is made of many other special studies concerning such matters as containers and crates for overseas shipments, for which designs were developed insuring the required strength while calling for a minimum shipping space, questions relating to the rapid drying of woods for gun stocks, artillery carriages, escort wagons and other vehicles, and investigations in connection with wood distillation products for various military uses. Much attention was given also to locating supplies of timber of various kinds and to stimulating production.

DEATHS FROM INFLUENZA AND PNEUMONIA

The Bureau of Census has issued the following figures of deaths from influenza and pneumonia in large cities of the United States from September 14, 1918, to January 25, 1919.

	Influenza	Pneumonia
Albany	527	150
Atlanta	59	610
Baltimore	1,773	2,652
Birmingham	839	228
Boston	4,480	1,291
Buffalo	2,007	790
Cambridge	485	179
Chicago	7,329	5,071
Cincinnati	1,721	275
Cleveland	2,828	1,113
Columbus	666	180
Dayton	495	196
Denver	1,294	404
Fall River	714	109
Grand Rapids	94	228
Indianapolis	156	856
Jersey City	303	592
Kansas City	1,342	635
Los Angeles	2,482	517
Louisville	141	936
Lowell	165	477
Memphis	115	548
Milwaukee	339	1,172
Minneapolis	978	159
Nashville	580	224
Newark	1,418	930
New Haven	882	206
New Orleans	2,022	985
New York	13,641	13,795
Oakland	931	230
Omaha	930	141
Philadelphia	8,367	5,959

Pittsburgh	2,224	2,760
Portland	1,185	146
Providence	1,022	475
Richmond	657	285
Rochester	969	236
St. Louis	2,084	1,192
St. Paul	855	171
San Francisco	3,088	538
Seattle	1,160	157
Spokane	449	39
Syracuse	821	168
Toledo	538	280
Washington, D. C.	2,217	694
Worcester	866	286
Total	78,238	49,265

SALT REQUIREMENTS OF REPRESENTATIVE AGRICULTURAL PLANTS

The Division of Biology of the National Research Council has organized a nation-wide cooperation among plant physiologists and agricultural chemists, concerning the general problem of the physiological requirements of certain representative agricultural plants. This project is in charge of a special committee consisting of B. E. Livingston (Johns Hopkins University), K. F. Kellerman (U. S. Department of Agriculture), and A. F. Woods (Maryland Agricultural College).

It is planned that the cooperation will carry out experimental work, by water and sand cultures, on wheat and soy bean, for a beginning. The first problem is to determine the best total concentrations and the best sets of salt proportions with 3-salt mixtures, each plant studied being considered in several phase of its development. For wheat these phases are: (1) the germination phase (till plantlets are 4 cm. high), (2) the seedling phase (for 4 weeks following the germination phase), (3) the vegetative phase (from end of seedling phase to appearance of flowers), and (4) the reproductive phase (from end of vegetative phase to the ripening of grain). Each phase is to be treated separately, the plants having been grown with the best 3-salt solutions for the preceding phases, respectively. Twenty-one different sets of salt proportions are to be tested with each of the six types of possible 3-salt solutions.

It is hoped that these tests may be made by a large number of experimenters in different places, all using the same methods so that the results may be comparable, and that many different climatic complexes and seasons of the year may be thus included. The general problem falls naturally into convenient portions, so that any worker or group of workers may confine attention to a certain more or less restricted field. All seeds will be supplied from the same source. Of course each worker will publish his results as he may desire, with whatever interpretation may seem warranted. It is hoped that out of this cooperation may result a clear and definite advance in our knowledge of this aspect of nutritional physiology, which not only may be valuable in a scientific way but also may furnish valuable suggestions to those who are experimenting with the fertilizer treatment of crop plants in the field. It is suggested that the results of this correlated set of researches may become a definite national contribution to knowledge about one of the most important and fundamental of all physiological problems. The cooperation was planned in war-time, but is is as much needed in time of peace as in time of war, and it is being pushed forward with all reasonable haste.

The Special Committee on Salt Requirements of Representative Agricultural Plants has prepared a comprehensive plan for the project, which may be obtained on request, and has made arrangements for special lots of chemicals for this work, also for the special cork supports needed in water cultures. Correspondence regarding this project is earnestly requested, and all experimenters in this field are asked to join in this national undertaking in one way or another. Correspondence should be addressed to the chairman of the special committee, at the laboratory of plant physiology of the Johns Hopkins University, Baltimore, Md.

MEETING OF THE AMERICAN INSTITUTE OF MINING ENGINEERS

Lessons learned from the war by the American mining world will be applied toward

greater progress in American mining at the one hundred and nineteenth meeting of the American Institute of Mining Engineers, which will be held here during the week of February 17. Prominent members of the Canadian Mining Institute, National Research Council, the American Institute of Electrical Engineers will join the American mining experts in their discussions.

At no period in the history of American mining have the problems of production, especially as to labor and scientific processes, been so momentous as to-day and at this meeting important readjustment plans will be presented. The program calls for ten business sessions, at which some forty subjects will be presented; a number of social features of a metropolitan kind, and an all-day excursion to the federal shipyard in Newark Bay where the first electric-welded ship is being built.

It is expected that this meeting of the institute will be attended by mining experts from every state in the union and from a number of foreign countries, who are identified with the most important mining operations now going on. Many of these men have in the past two years been serving the government in their respective fields.

At the joint session with the electrical engineers there will be six important papers on the subject of electric-welding. Some of these by officials of the National Research Council and Emergency Fleet Corporation, who have participated in the development of electric-welding which has made great strides forward in the war work of the last two years.

The institute meeting will open on Monday morning, February 17, Tuesday will be Canadian Mining Institute day and Wednesday will be featured by the session with the electrical engineers and the National Research Council session, followed by the annual banquent in the evening.

The officers of the American Institute of Mining Engineers are: Sidney J. Jennings, *president;* L. D. Ricketts, Philip N. Moore, *past presidents;* C. W. Goodale, *first vice-presidents;* George D. Barron, *treasurer;* Bradley Stoughton, *secretary.*

SCIENTIFIC NOTES AND NEWS

Edward Charles Pickering, professor of astronomy in Harvard University and director of the Harvard College Observatory, died on February 3 at the age of seventy-two years.

To oversee the opening of the port of Dantzig and to supervise relief work there Professors Alonzo Taylor, of the University of Pennsylvania, and Vernon L. Kellogg, of Stanford University, started on January 29 on a railroad journey across Germany. Drs. Taylor and Kellogg will, on their return, make a report on food conditions in Germany.

Major C. E. Mendenhall, professor of physics on leave of absence from the University of Wisconsin, has been appointed scientific attaché to the United States legation at London and will sail for England immediately.

Dr. Alexis Carrel, who had been in charge of a field hospital in the Montdidier section, has returned to take up his work at the Rockefeller Institute for Medical Research.

Brigadier-General John M. T. Finney, of Baltimore, chief consulting surgeon of the American Expeditionary Forces, who sailed nineteen months ago for France as head of the Johns Hopkins Base Hospital Unit, returned to the United States on January 22.

Lieutenant Colonel Allerton S. Cushman, having received his honorable discharge from the Ordnance Department, U. S. A., where he has served for the past eighteen months, has returned to his former professional activities as head of the Institute of Industrial Research, Washington, D. C.

Lieutenant Colonel J. H. Hildebrand has returned after an absence of a year in France to his position of professor of chemistry in the University of California. He has been recently Commandant of Hanlon Field, near Chaumont, which included the Experimental Field and the A. E. F. Gas Defense School of the Chemical Warfare Service.

Major J. H. Mathews, Ordnance Department, U. S. A., has been released from military service and has returned to the University of Wisconsin. Professor Mathews has been pro-

moted to a full professorship, and has resumed his work in physical chemistry.

CAPTAIN R. H. WHEELER, professor of psychology in the University of Oregon, who has been conducting psychological tests in the army, has returned to take up his work at the university.

MAJOR MAURICE DAUFRESNE, the well-known French chemist is visiting the United States.

L. E. CALL, head of the department of agronomy in the Kansas State Agricultural College, is leaving for France, where he will have charge of the work in grain crops for soldiers taking work in agriculture.

PROFESSOR CHARLES E. MUNROE, of George Washington University, chairman of the Committee on Explosives of the National Research Council, visited Boston to make an investigation of the circumstances connected with the recent collapse of a huge molasses tank which caused the death of several people.

WE learn from the *Journal of the American Medical Association* that Lieutenant Colonel H. Gideon Wells, Chicago, left the United States early in November as a member of the Balkan commission of the American Red Cross. The armistice and the cessation of hostilities made necessary a change in plans. He has now been detached from the position in connection with the commission to the Balkan states, and has been appointed commissioner representing the Red Cross in Roumania. He has organized a commission of sixty-eight persons to undertake general relief work instead of medical relief work alone, as there is a well developed medical profession in Roumania. The medical men of the party, aside from Lieutenant Colonel Wells, are Lieutenant Colonel Morley D. McNeal, of Johns Hopkins, Baltimore, and Major J. Breckenridge Bayne, Washington, D. C. The latter was two years in Roumania, kept there practically as a prisoner during the German occupation, although allowed to do medical work among the Roumanian people.

AT the annual meeting of the Association of of American State Geologists held in Baltimore, December 27–28, 1918, the following officers were elected for the year 1919: W. O. Hotchkiss (Wisconsin), president; Edward B. Mathews (Maryland), member executive committee; Thomas L. Watson (Virginia), secretary. The association was addressed on December 28 by Messrs. George Otis Smith, director, United States Geological Survey; H. Foster Bain, assistant director, Bureau of Mines and Professor John C. Merriam, of the National Research Council. The following standing committees were appointed: *Cooperative geological problems:* H. A. Buehler (Missouri), chairman, J. M. Clarke (New York), J. A. Udden (Texas), and J. Hyde Pratt (North Carolina). *Strengthening of State Surveys:* H. B. Kümmel (New Jersey), chairman, H. E. Gregory (Connecticut), and W. H. Emmons (Minnesota). *Topographic mapping:* W. O. Hotchkiss (Wisconsin), chairman, F. W. DeWolf (Illinois), and R. C. Allen (Michigan.).

THE board of commissioners of the Wisconsin Geological and Natural History Survey at a meeting held in the office of Governor Philipp on January 16, 1919, elected President E. A. Birge, of the University of Wisconsin, as president of the board of commissioners. Owing to his new duties Dr. Birge felt it incumbent upon him to resign from the position of director and superintendent of the survey, which position he has held since it was organized in 1897. W. O. Hotchkiss, who has been state geologist for the survey since 1909 was made director and superintendent in addition to holding his present position as state geologist.

PROFESSOR A. M. CHICKERING, of Albion College, Michigan, has recently been elected to the vice-presidency of the section of zoology of the Michigan Academy of Science, to fill out the unexpired term of Professor Leathers, of Olivet College.

W. M. SMALLWOOD, professor of comparative anatomy, Syracuse University, is spending the second semester on leave of absence at the University of Minnesota, working with Dean J. B. Johnston in comparative neurology.

PROFESSOR A. LAVERAN, a member of the Paris Academie de médecine since 1893, has

been elected vice-president for 1919, automatically becoming president in 1920.

At the meeting of the Washington Academy of Sciences on January 30, Major F. R. Moulton gave an address on the "Deviation of the stars."

Dr. Gregory P. Baxter, professor of chemistry at Harvard University, is giving at the Lowell Institute, Boston, a series of lectures on "Chemistry in the war."

William Erskine Kellicott, professor of biology at the College of the City of New York, died on January 29, at the age of forty years.

Dr. Brown Ayres, since 1904 president of the University of Tennessee and previously professor of physics and dean of the School of Technology of Tulane University, died on January 28, aged sixty-two years.

UNIVERSITY AND EDUCATIONAL NEWS

A school for social research in New York City has been organized to meet the needs of those interested in social, political, economic and educational problems. The school will open with a full program in October, 1919. In the meantime, lectures will be given from February 10 to May 3 by Professor Thorstein Veblin, James Harvey Robinson, Charles A. Beard and others.

Dr. W. R. Bloor, formerly assistant professor of biological chemistry at the Harvard Medical School, Boston, Mass., has been appointed professor of biochemistry and head of the division of biochemistry and pharmacology at the University of California.

Mr. C. S. McKellogg, corporal in the Chemical Warfare Service, stationed at the American University, has been furloughed to the University of Mississippi as assistant professor of chemistry, where he is to have charge of the work in organic and physiological chemistry.

Dr. Léon Frédericq, who was professor of physiology at Liége and later at Ghent, was imprisoned by the Germans because he refused to continue his courses in Flemish after the Germans had taken the city and were trying to remodel the university to be a Flemish institution. The government of Belgium has now appointed Professor Frédericq lord rector of the university.

Dr. Jules Duesberg, will sever his connections as a member of the faculty of the Johns Hopkins University and will sail for Belgium on February 12. Dr. Duesberg went to Baltimore in 1915. He is is a native of Liége and in 1911 was made professor of anatomy at Liége University, where he will now resume his work.

DISCUSSION AND CORRESPONDENCE

ON MONKEYS TRAINED TO PICK COCO NUTS

Readers of the Sunday editions of some of our metropolitan papers may recall that in the fall, the season of cotton picking in the South, waggish space writers sometimes make the suggestion that monkeys be trained to do this work and that thereby the shortage of labor be relieved.

In this connection there have come under my notice during the past year accounts showing that in a far distant part of the world monkeys are trained to do service which, for want of a better descriptive title, may be called manual labor. The first of these is from the well-known woman traveller, Isabella Bird. In her interesting book "The Golden Chersonese and the Way Thither" (1883) she writes on page 425:

> A follower had brought a "baboon," an ape or monkey trained to gather coconuts, a hideous beast on very long legs when on all fours, but capable of walking erect. They called him a "dog-faced baboon," but I think that they were wrong. . . . He is fierce, but likes or at all events obeys his owner, who held him with a rope fifty feet long. At present he is only half tame, and would go back to the jungle if liberated. He was sent up a coconut tree which was heavily loaded with nuts in various stages of ripeness and unripeness, going up in surly fashion, looking around at intervals and shaking his chain angrily. When he got to the top he shook the fronds and stalks, but no nuts fell, and he chose

a ripe one, and twisted it round and round till its tenacious fibers gave way, and then threw it down and began to descend, thinking he had done enough, but on being spoken to he went to work again with great vigor, picking out all the ripe nuts on the tree, twisted them all off, and then came down in a thoroughly bad, sulky temper. He was walking erect, and it seemed discourteous not to go and thank him for all his hard toil.

More to the point is the account given by Robert W. C. Shelford in his book "A Naturalist in Borneo" (London, 1916). This book is packed with interesting natural history data on a great variety of subjects gathered while he was curator of the museum founded by the great Rajah Brooke at Sarawak. On page 8, Shelford says:

Macacus nemestrinus, the pig-tailed Macaque or *Brok* of the Malays, is a highly intelligent animal, and the Malays train them to pick coconuts. The *modus operandi* is as follows: A cord is fastened round the monkey's waist, and it is led to the coconut palm which it rapidly climbs. It then lays hold of a nut, and if the owner judges the fruit to be ripe for plucking he shouts to the monkey, which then twists the nut round and round till the stalk is broken and lets it fall to the ground. If the monkey catches hold of an unripe fruit, the owner tugs the cord and the monkey tries another. I have seen a *Brok* act as a very efficient fruit-picker, although the use of the cord was dispensed with altogether, the monkey being guided by the tones and inflections of his master's voice.

E. W. Gudger

Greensboro, N. C.

HAY-FEVER AND A NATIONAL FLOWER

The Independent recently conducted what might be called a popular voting contest in order to ascertain the favorite candidate for a national flower. The result is published in the issue of that magazine for October 26, 1918, and can be summed up in the introductory words of the article:

We supposed that it would be merely a choice between the two leading candidates, the goldenrod and the columbine, but to our surprise three other flowers ran neck and neck with them: the sunflower, the clover and the daisy, while there were besides a dozen also-rans. The candidates were so numerous and the votes so scattering that we must declare the election void.

In the same article, in commenting on the goldenrod, they say:

The hay-fever vote is something that every floral politician must consider, for it is undeniably influential. Still, the advocates of the goldenrod do not propose to toady to any such selfish interests.

The writer sincerely hopes this is not an expression of the general opinion concerning the sufferers from the malady misnamed hay-fever. Stories of the victims of this disease too often get into the funny papers in the same column with mother-in-law jokes—they both deserve to receive more consideration at the hands of the public at large.

Hollopeter[1] states that hay-fever is largely due to the action of the pollen of the ragweed and of the goldenrod, the former being eighty-five per cent. guilty while the latter is responsible for the remaining fifteen per cent., not taking account of some few cases probably caused by the pollen of other plants. This seems to reduce the harm done by the goldenrod to a small amount, but it must be remembered that almost all cases are irritated by the pollen of this plant whether or not it is the specific cause of the attack.

Between one and two per cent. of our adult population probably either has hay-fever or is liable to contract it if the proper conditions arise. The efficiency of the victims is reduced during the attack a great deal, in some cases even causing them to be confined to their homes for a month or six weeks every fall. It is true that on this point there is great variation, but all victims have a lowered vitality. Such a loss of time and efficiency is not only a detriment to the individual but is also a loss to the community. Why should we aid in the preservation and spread of a plant of such propensities, even if it is good to look upon? Rather it should be classed with the ragweed, and every effort should be made to stamp it out, at least in the neighborhoods of our cities.

1 Hollopeter, W. C., "Hay-fever, Its Prevention and Cure," New York, 1916.

If we do not care to eliminate the goldenrod from the national flower contest because of thoughtfulness for our friends and neighbors who suffer from its existence, let us do so merely from the efficiency standpoint, both individual and state. HORACE GUNTHORP

WASHBURN COLLEGE,
TOPEKA, KANS.

SCIENTIFIC BOOKS

The Theory of Relativity of Motion. By R. C. TOLMAN. University of California Press. ix + 225 pp.

This book, which the author calls an introduction to the theory of relativity, is very attractive in style, sufficiently accurate, and covers the subject rather thoroughly. After a brief sketch of the historical development and statement of the postulates on which Einstein founded the theory, there is a very interesting chapter containing "elementary deductions" of some of the most striking results. This chapter makes it possible for students of physics to get a fairly definite idea of the subject without the rather perplexing mathematics in which it is usually hidden. Unfortunately the author finds it necessary to state that observers moving relatively to each other would find the same measurements perpendicular to the line of motion because they could make a direct comparison of their meter sticks when the motion brings such meter sticks into juxtaposition. There is nothing in the previous discussion that shows why this applies when the meter sticks are perpendicular to the line of motion and not when they are parallel to it.

A reader interested in the formal development would perhaps turn first to the chapter on the Lorentz transformations for, as Poincaré pointed out, these constitute the real essence of relativity. Most writers have some difficulty in logically deducing these from Einstein's postulates, the reason apparently being that it can not be done. The author avoids this difficulty by showing that the transformations do satisfy the postulates without attempting the impossible converse.

The applications cover the dynamics of a system of particles, elastic bodies, thermodynamic systems, and electromagnetic theory. In a chapter on the chaotic motion of a system of particles there is given what amounts to statistical mechanics in the form required by the principle of relativity. The last chapter is an introduction to the four-dimensional vector analysis used by Wilson and Lewis. This will be welcomed by many readers who have struggled with the original. The book does not enter into the extended relativity proposed by Einstein in connection with his speculations on gravitation. H. B. PHILLIPS

SPECIAL ARTICLES

ON EXPLAINING MENDELIAN PHENOMENA

So many devices have been invented for representing the possible combinations of the various factors in Mendelian inheritance that one comes to entertain a suspicion that other folk have their troubles also in the presentation of this subject to beginners. The following suggestion is offered as having helped in serious cases. The beginning student of heredity is dealing with unfamiliar terms and, unless considerable laboratory work has rendered him no longer a beginner, he is considering unfamiliar processes. In his quicksand of strangeness he is glad to find a firmament of familiarity and he, therefore, welcomes a process of reasoning or of routine that he has employed before. Practically every high school graduate has had at least a year of algebra and has learned by rote the square of $a + b$. Whether or not he remembers that $a^2 + 2ab + b^2$ represents all the possible combinations of the two factors, he is in a position to be reminded of that fact and to take the first short step into the unfamiliar. If a and b represent the two types of gametes produced by the heterozygous parents F_1, then $a^2 + 2ab + b^2$ represents all possible progeny in the F_2 generation. Factors of second power represent pure strains because the determiner is the same from both parents. Conversely factors of the first power represent heterozygotes or the union of unlike determiners.

The greatest service of this method appears when the two sets of allelomorphs are combined. The student has learned to multiply $a^2 + 2ab + b^2$ by the expression $x^2 + 2xy + y^2$. He will perform the operation as one familiar to him and he can readily be taught to recognize the four pure strains a^2x^2, a^2y^2, b^2x^2, b^2y^2. Suppose a and y represent the dominant characters and b and x represent the recessives, emphasizing the fact that the dominant is effective whether appearing as the first or as the second power. Suppose a represent tallness and y represent red flower in a plant. Gathering the results of the multiplication according to visible attributes we have four columns representing the Mendelian ratio 9:3:3:1.

Tall Red	Tall White	Dwarf Red	Dwarf White
$2a^2xy$ $4abxy$ $2aby^2$ a^2y^2	a^2x^2 $2abx^2$	b^2y^2 $2bxy$	b^2x^2
9	3	3	1

This is only one of many devices all alike fundamentally but it has the great value of utilizing a familiar process. Many times I have seen it clear up a badly fogged situation. It is worth trying on the discouraged pupil at any rate.

LOYE HOLMES MILLER

STATE NORMAL SCHOOL,
LOS ANGELES, CALIF.

SILEXITE: A NEW ROCK NAME

IN the granites of the Adirondack region the writer has observed many bodies of pure or nearly pure silica of igneous origin in the form of dikes segregation masses practically *in situ*, or inclusions. Among many other districts where similar masses of silica occur is the Silver Peak quadrangle of Nevada in an account of which Spurr has described many considerable bodies of quartz of magmatic origin. Numerous fine examples of so-called "quartz dikes" occur in the Holyoke quadrangle of western Massachusetts described by Emerson. The need for a definite name to apply to any such body of silica has impressed itself upon the writer during the preparation of a discussion of the acidic dikes of northern New York. Such terms as "quartz dikes" or "dike quartz" are not comprehensive enough, first, because much of the silica under consideration is not in dike form, and, second, because the silica may be either quartz or tridymite depending upon the temperature of crystallization.

The term "selexite" is proposed for any body of pure or nearly pure silica of igneous or aqueo-igneous origin which occurs as a dike, segregation mass, or inclusion within or without its parent rock. This term is based upon the name "silex" used by Pliny in his "Natural History" for the mineral now known as quartz. "Silexite," therefore, not only has the advantage of simplicity as a name, but also it directly suggests the composition of the rock which it names.

WILLIAM J. MILLER

SMITH COLLEGE

THE WESTERN SOCIETY OF NATURALISTS

THE Bay Section of the society held a two-day meeting at Stanford University, November 29–30, 1918. The sessions, held in Jordan Hall, were well attended and the various papers which were of more than usual interest were enthusiastically received. Dr. Joseph Grinnell served as chairman. An informal dinner Friday evening and a field trip on Saturday afternoon were features of the occasion. Dr. S. D. Townley gave the evening lecture on "The recent solar eclipse."

The following papers were presented:

Isolation as a factor in species forming: DAVID STARR JORDAN, Stanford University.

A Thanksgiving Day registration of plants in bloom on Mt. Tamalpais: ALICE EASTWOOD, California Academy of Sciences.

Use of selective dyes in sanitary examination of water: IVAN C. HALL, University of California.

The naturalist's place in his community: E. W. ALLEN, Fresno High School.

Adaptation of the eyes of birds for rapid flight: J. R. SLONAKER, Stanford University.

Intrauterine absorption of conceptsuses: A. W. MEYER, Stanford University.

The relations between the salinity of water and the osmotic pressure of nereocystis: ANNIE MAY HURD, University of California.

Gistel's natural history: DAVID STARR JORDAN.

The English sparrow has arrived in Death Valley: J. GRINNELL, University of California.

The Steinhart Aquarium of the California Academy of Sciences: B. W. EVERMANN, California Academy of Sciences.

Some phases of plant succession due to grazing: C. H. SHATTUCK, University of California.

Larval stages of the Japanese blood-fluke, Shistosoma japonicum: W. W. CORT, University of California.

Genetic investigations of the Compositæ: E. B. BABCOCK, University of California.

New habitat groups in the museum of the California Academy of Sciences: B. W. EVERMANN.

Demonstration of a plankton net: W. E. ALLEN.

The discovery of some new white fishes in Bear Lake, Idaho: J. O. SNYDER, Stanford University.

The work of the Committee on Zoological Investigation of the Council of Defense of California: B. W. EVERMANN.

The Escalonias in Golden Gate Park: ALICE EASTWOOD.

The five-toed kangaroo rats of west-central California: J. GRINNELL.

Orthogenesis: DAVID STARR JORDAN.

Mussels of the Pacific Coast: E. P. RANKIN, U. S. Bureau of Fisheries.

The ovulation and Estrus cycle in the rat: J. A. LONG, University of California.

Bacteriology of peanut butter: IVAN C. HALL.

The inspection of foods in mills and warehouses: R. W. DOANE, Stanford University, California.

Structure of embryonic heart muscle: E. D. CONGDON, Stanford University.

What kinds of botany does the world need now: G. J. PEIRCE.

Papers were read for C. V. Taylor, Forrest Shreve and D. T. MacDougal, the authors not being present.

THE TENNESSEE ACADEMY OF SCIENCE

THE tenth meeting (seventh annual meeting) of the Tennessee Academy of Science was held on November 29, 1918, at Vanderbilt University, Nashville, Tenn., President John T. McGill presiding. The program was as follows:

Memorial Sketch of Dr. A. H. Purdue, by Dr. L. C. Glenn.

Annual address of the president, "Tobacco smoke; its composition and toxicity," by Dr. John T. McGill.

A vocational survey of the chemical industries of Nashville, by Professor H. A. Webb.

The effect of the Old Hickory Works upon Cumberland River water, by Dr. W. H. Hollinshead.

Reelfoot Lake water, by Dr. J. I. D. Hinds.

On the temperature of reduction with hydrogen, by Dr. J. H. Ransom and Dr. J. L. St. John.

The sulphur industry in the United States, by Miss Gretchen H. Lee.

The differential action of lime and magnesia upon the conservation of soil sulphur, by Professor W. H. McIntire.

Carbocoal, a new smokeless fuel from high volatile coals, by Dr. C. H. Gordon.

Geology as applied to warfare, by Wilbur A. Nelson.

The contributions of biology to winning the war, by Dr. E. E. Reincke.

Forestry and the war, by R. S. Maddox.

Uses of meteorology in the war, by Roscoe Nunn.

The geographic basis of the European war, by Professor A. E. Parkins.

The migration of the birds of the Mississippi Valley, with special reference to Reelfoot Lake, by W. D. Howser.

The future of the airplane, by Latimer J. Wilson.

The election of officers for the ensuing year resulted as follows:

President, Dr. L. C. Glenn, Vanderbilt University, Nashville, Tenn.

Vice-president, Professor Scott C. Lyon, Southwestern Presbyterian University, Clarksville, Tenn.

Editor, Dr. C. H. Gordon, University of Tennessee, Knoxville, Tenn.

Secretary-Treasurer, Roscoe Nunn, U. S. Weather Bureau, Nashville, Tenn.

ROSCOE NUNN,
Secretary

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EDWARD CHARLES PICKERING

BY the death of Edward C. Pickering American science has lost one of its most distinguished figures, one of the most noteworthy contributors to its progress during the past forty years, and one of its most inspiring and influential leaders. A full account of his long and active career would demand far more space for its presentation and time for its preparation than are at the moment available; only the main events and achievements of an exceptionally productive life can be touched upon in these few words of appreciation.

Born at Boston, in 1846, of an old New England family, and a graduate of Harvard of the class of 1865, after two years as instructor in mathematics, he became professor of physics at the Massachusetts Institute of Technology, where he established the first laboratory in America in which students were instructed by actual contact with physical instruments and measurements. Upon the death of Professor Winlock, the youngest physicist was called, in 1877, at the age of thirty-one, to the directorship of the Harvard College Observatory, which he held for nearly forty-two years, continuing the tradition of the institution, all of whose directors have died in office.

At this time most observatories were devoting themselves mainly to the old "astronomy of position"—the determination of the apparent positions of the stars and other heavenly bodies upon the celestial sphere, and of those constants of nature which can be derived from such observations—and the "new astronomy" (now bet-

ter known as astrophysics) was in its infancy. It is characteristic of Pickering that he realized at once in what direction the greatest opportunities lay, and set to work to employ the full resources of the observatory in fundamentally important work. Harvard had always been sympathetically inclined towards the newer developments of astronomical science, and considerable photometric work had been done under Bond and Winlock; but, when the new director began to devote the main portion of his own time, and that of the fifteen-inch telescope (then one of the greatest in the country) to photometric researches, considerable criticism was aroused. "Why," said these critics, "should observations with the meridian circle and micrometer, which yield results accurate almost to one part in a million, be neglected in favor of measures in which differences of five, or even ten per cent. habitually occur? Can such inaccurate observations be of any value in an exact science?"

Undaunted by these cavils, he continued in his chosen course—with what abundant reason the nearly eighty volumes of the "Harvard Annals" which appeared during his directorate may testify. The "old astronomy" was not neglected—in fact, twenty years' time was spent by several members of the staff in preparing each of the two Harvard zones of the Astronomische Gesellschaft's scheme of international cooperation in star-cataloguing—but the astrophysical work accomplished under Pickering's directorship, and bearing the marks of his genius, is of incomparably greater volume and importance. He was a pioneer in several fields, in each of which he has had many followers.

He was never contented with the unthinking adoption of the methods and instruments of investigation which he found in use, but was always designing new ones, with a view to increasing the accuracy of observation, and, above all, to obtaining rapidity without sacrificing accuracy. In the latter particular he was indeed a master. He possessed a genius for organization which would undoubtedly have brought him both wealth and fame in the world of business: but he preferred to devote these talents to the service of science, and, because of them, enjoyed work of a sort which most other men would have regarded as drudgery. He once said to the writer, "I *like* to undertake large pieces of routine work." In the great masses of such work done under his direction, the principles of "scientific management" were fully applied. All that could be done by assistants of moderate capacity was left to them, and the whole working time of the experienced specialists was devoted to such parts of the work as they alone could do. To extend the study to the stars of the southern hemisphere, a station was established at Arequipa, Peru, in 1890, and has been actively maintained ever since, and another has more recently been set up in the island of Jamaica.

The results of these carefully reasoned plans have been so extensive that only the principal features can be mentioned here, leaving a host of minor but highly interesting investigations undescribed.

In *visual photometry*, Pickering started almost *de novo*, devising new measuring instruments, with which observations of all the accuracy necessary for his purpose could be made with great rapidity—notably the meridian photometers, with which the brightness of stars is measured, as they cross the meridian, by comparison with some circumpolar star which is always available as a standard. With these instruments more than 45,000 stars have been observed at Cambridge and Arequipa, and the resulting system of visual stellar magni-

tudes has been generally adopted as an international standard. When to these observations, most of which were made by Professor Pickering himself, are added his numerous measures upon variable stars, satellites and other objects, the whole number of photometric settings which he personally made rises to the amazing total of more than a million and a half.

He was also a pioneer in *stellar photography,* and especially in the use of the doublet lenses which combine great light grasp with a wide angle of field, and can with an exposure of an hour or two, record on a single plate the positions and magnitudes of a number of stars which may run into the hundreds of thousands. The Harvard equipment includes instruments of this type ranging from the 24-inch Bruce telescope at Arequipa and the 16-inch Metcalf instrument at Cambridge to the little lenses of one inch aperture which are used to photograph as large a portion of the visible heavens as possible on every clear night. The plates are developed, indexed, and filed in the great "Harvard Photographic Library," which its creator described as "a library of 250,000 volumes, every one unique, and with but a handful of readers to work in it." The very magnitude of the mass of information stored in this vast collection makes it impossible to extract it all; but whenever an object of unusual interest is discovered, it is only necessary to refer to the Harvard plates to find out just where and how bright it was on some three or four hundred dates during the last thirty years. Among the most notable examples of this may be mentioned the recognition of images of the asteroid Eros upon plates taken two and four years before its discovery, and the recent tracing of the history of the brilliant new star in Aquila through an interval of thirty years, up to the very day before the great outburst.

The third principal field of work is in *stellar spectroscopy.* Pickering led again in the photography of stellar spectra with the objective prism, and in the more precise classification of stellar spectra which this made possible. Assisted financially by the liberal aid of the Henry Draper Memorial, he and his very distinguished assistants, Mrs. Fleming and Miss Cannon, studied these spectra, devised the empirical classification of the original Draper Catalogue, and improved upon this by omitting some of the original classes and rearranging others, until the resulting classification proved so convenient, and so remarkably representative of the actual facts, that it was adopted without a dissenting voice by the International Union for Solar Research as a universal standard. The fact, which was first brought out by this investigation, and served as the basis of the final classification, that the spectra of almost all the stars fall into a single sequence, along which each type grades almost imperceptibly into the next, is now recognized as the very foundation of modern astrophysics, and the progress of discovery serves steadily to emphasize the importance of classification according to spectral type in the most diverse problems of sidereal astronomy. In this field, too, the Harvard work is of imposing extent, culminating in the "New Draper Catalogue" containing the spectra of about 215,000 stars, classified by Miss Cannon. Professor Pickering took the liveliest interest in this monumental work, and in the admirably arranged plans for its production; and it is cause for gratification that the first volume saw the light while he was alive to enjoy it.

One other series of investigations that should not be passed over deals with *photographic photometry.* This was one of the chief interests of his later years, and an increasing part of the work of the observa-

tory was devoted to it. The establishment of a standard system of photographic magnitudes proved a difficult and intricate problem, but again the results are of primary importance, for the color of a star, which is best measured by the difference between its visual and photographic magnitudes, proves to be almost as important as its spectral type, to which it is very intimately related. Here again the principal work of observation was done by others—Miss Leavitt, Professor Bailey and Professor King—but the unifying guidance was Pickering's. Closely related to this is the discovery of variable stars, which, previously largely a matter of chance, was reduced to a system, whether by the comparison of plates of the same field taken at different times, or by means of certain spectral peculiarities. The new methods were so successful that the number of variable stars discovered at Harvard within a few years was three times as great as that of all those detected by all the astronomers of the world during the previous history of the science.

Finally, and by no means least, should be recorded his deep interest in, and support of, cooperation between the whole fraternity of astronomers, whether in this country or abroad. There was hardly an organization for the furtherance of any specific astronomical aim, such as the Committee on the "Carte du Ciel" or the Solar Union, in which he did not take an active part, and his counsel and advice were always of weight. But equally influential, though less conspicuous, was his ever generous aid to individual investigators, to whom he was continually transmitting invaluable material from the treasures under his charge, sometimes observations already made, but unpublished, and again data concerning stars which had been put upon his observing lists for that especial purpose. His abiding willingness to use his powerful influence to aid other astronomers in obtaining instruments for the expansion of their researches, or funds to provide assistance in the reduction and publication of their observations, is known to all.

It may be pardonable to speak of one or two instances. In conversation, referring to the Metcalf Telescope, for which he had found the funds to purchase the glass disks for the lens, and provide the mounting, while the figuring of the lens was done, as a labor of love and in his spare time, by the distinguished amateur whose name it bears, "I felt as if a great artist had said to me 'If you will buy the canvas, and the brushes and paint, I will paint you a picture.' "

If a more personal allusion may be excused, it may be recorded that, shortly after the writer's first interview with Professor Pickering (during which he had described his first serious astronomical work, on stellar parallax) a letter arrived from Harvard, saying in substance "I think that it would be useful to determine the magnitudes and spectra of all your stars. If you will send me a list of them, we will have them observed, and send you the results." This involved the photometric and spectroscopic observation of some three hundred stars (the photometric settings being made by Professor Pickering himself) and was offered as an unsolicited contribution to the work of a young and unknown instructor!

The Harvard Observatory never admitted graduate students of the ordinary sort; and doctoral theses are absent from the long list of its publications. But, under Pickering, it was an educational center of the first rank, and its pupils were not the immature students, but the working astronomers of the country. Who among us has not gone to Harvard, enjoyed the delightful hospitality and finished courtesy of the director, and returned, loaded down with

data for investigations new or old, and inspired by his experience with new enthusiasm alike for the magnificent researches of the great observatory, and for his own humbler work?

Such a career deserved unusual recognition, and received it in a merited degree. Almost all the honors of the scientific world fell to his lot, and the list of these distinctions is too long to detail here. But those who knew him will mourn less the disappearance of the distinguished leader of science than the loss of a warm and loyal friend, one of the kindliest and most generous of men.

Henry Norris Russell

Princeton University Observatory,
February 6, 1919

SOME RECENT CONTRIBUTIONS TO THE PHYSICS OF THE AIR[1]

There has come to us from ancient times the story of a foolish man who sold his birthright for a mess of pottage, and that story to-day is right applicable to us physicists, except in one important particular—we haven't even got the pottage. No department of learning has a richer birthright than has the department of physics in meteorology—the physics of the air. And yet the few institutions that even profess to teach this subject in any form offer it through the department of geology, or, more frequently still, that omnivorous department which, for want of a better name, is called the department of geography. Statistical meteorology, if such expression will be permitted, or climatology, is of course of great interest alike to the geologist and the geographer and this they should teach and in great measure do teach, but climatology is no more meteorology than descriptive geography, for instance, is geology. Its value is great and unquestioned, but its function, like the function of geography, is merely to describe and not to explain.

Meteorology, on the other hand, is concerned with causes, it is the physics of the air, a vast subject of rapidly growing importance upon which peace and war alike are becoming more and more dependent. Only yesterday we

Heard the heavens fill with shouting, and there rained a ghastly dew
From the nations' airy navies grappling in the central blue;

and to-day

Saw the heavens fill with commerce, argosies of magic sails,
Pilots of the purple twilight, dropping down with costly bales.

It is, therefore, no longer an opportunity, a shamefully neglected opportunity, that invites, but an imperative duty that commands our leading institutions to add to the various subjects taught, studied and investigated in their departments of physics that eminently valuable and fascinatingly difficult branch of geophysics—the physics of the air.

No doubt the great majority of colleges and universities would find it highly impracticable to add a proper course in meteorology to their present long list of electives. Neither is it practicable nor desirable for all of them to teach anthropology, say, despite its fascination, nor even any whatever of the a-to-z kinds of engineering. But it is insisted with all possible emphasis that if taught at all it be taught right—taught as a branch of physics. It is also insisted that there is a growing need, especially in connection with both the science and the art of aviation, for young men who understand the phenomena of the atmosphere. Nor should it be forgotten that when our army called for men trained in meteorological physics it called in vain—they did not exist. Furthermore, it would be a godsend to our national Weather Bureau if in the future it could secure a larger portion of its personnel from among university gradu-

[1] Address of the vice-president and chairman of Section B—Physics, American Association for the Advancement of Science, Baltimore, December, 1918.

ates highly trained in the subjects with which they have to deal. And, finally, it is insisted that the physics of the air offers many opportunities to the creative scholar, and every university must realize that its paramount duty is the fostering of research and the training of investigators, for in no other way can it meet the growing and compelling demands of a progressive civilization.

It must be admitted, however, that it is not now easy to give a connected course on atmospheric physics, for there is no suitable text and the isolated articles upon which such a course must needs be based are scattered through the journals from Dan to Beersheeba and buried under a babel of tongues. But this is only a difficulty, and not, in the face of imperative needs, an excuse. A far greater and very real difficulty has, it is true, confronted most of us, for, until the last decade, or less, several important lectures in such a course would of necessity have been restricted to the same brevity as characterizes Horrebow's famous chapter on snakes in his "Natural History of Iceland"—there aren't any.

Some of these lectures are still unwritten—tantalizing challenges to the skill of the experimentalist and acumen of the analyst—while others have been at least partially supplied, a few of which it will be interesting to review in what follows.

TEMPERATURE OF THE FREE AIR

Although efforts to determine the temperature of the free air by means of thermometers carried by kites were made as early as 1749, the experiments being conducted at Glasgow by Alexander Wilson and his pupil Thomas Melville; and although, beginning with Jeffries in his ascent from London in 1784, balloonists have often carried thermometers on their flights, it was only after the development of self-recording instruments and the sounding balloon—both at the very end of the last century—that the vertical distribution of temperature up to even 7 or 8 kilometers became at all accurately known. As is now known, and as shown in Fig. 1, the average temperature decreases slowly with elevation near the surface, then more and more rapidly to a maximum at some such considerable altitude as 7 to 9 kilometers, where it roughly approaches the adiabatic rate for dry air of approximately 1° C. per 103 meters.

These are the observed facts; but here too, as in the investigations of other physical phenomena, a knowledge of what happens is only so much raw material out of which some one happily may fashion the finished product—why it happens. In this case the why is found in the presence of water vapor in the air, its condensation and the latent heat thus rendered sensible. As air is carried to higher levels by vertical convection it progressively expands against the continuously decreasing pressure, and thereby does work at the expense of its own heat. During the dry stage of this convection, that is, until saturation is attained, the cooling is roughly at the rate of 1° C. per 103 meters increase of elevation. Immediately condensation begins, however, latent heat is set free and the rate of cooling with elevation correspondingly decreased. But as the amount of vapor condensed per degree drop in temperature decreases with the temperature, it follows that the latent heat set free and the corresponding check in the rate of cooling with elevation also decreases. Hence the continuous temperature-elevation coordinates of a rising mass of saturated air form a curved line. Furthermore, the curve thus formed approximately coincides with the average temperature-altitude curve of the free air throughout all cloud levels, or from 0.5 kilometer, say, to 9 kilometers, or thereabouts, above sea level. This agreement necessarily occurs more or less closely during every rain and in all deep clouds and, therefore, very frequently. Nor can there often be much departure from it between such occasions for during these intervals the whole of this portion of the atmosphere is, as a rule, simultaneously warmed or cooled, and thus the curve in question usually shifted essentially parallel to itself.

It appears, then, that the average tempera-

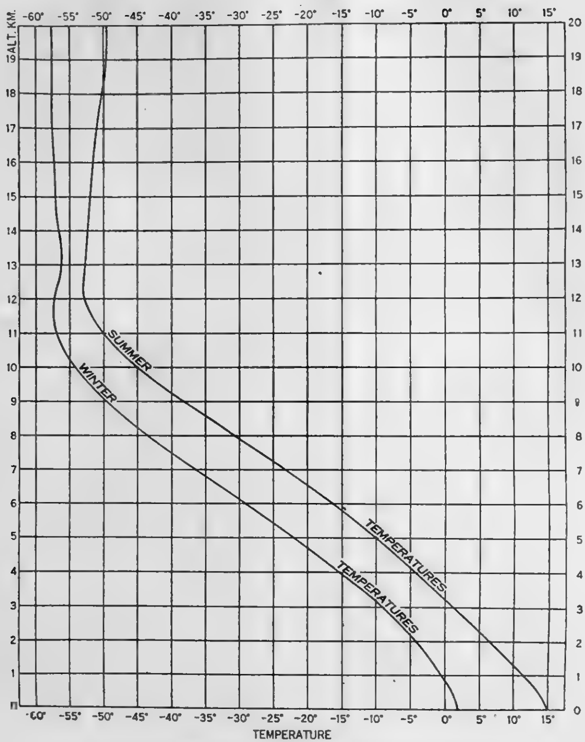

Fig. 1. Temperatures of the air at different elevations.

ture gradient (rate of decrease of temperature with elevation) of the free air is approximately that of a rising mass of saturated air; and for the reasons (*a*) that frequently the air is rising and saturated, and (*b*) that departures from the thus established saturation curve develop but slowly, as explained, and are soon eliminated by its reestablishment.

THE ISOTHERMAL STATE OF THE UPPER AIR

In April, 1898, Teisserenc de Bort began at Trappes, near Paris, a long series of frequent atmospheric soundings with small balloons carrying automatic registering apparatus. Among other things, he soon obtained temperature records that indicated the existence either of surprising errors in his apparatus, or of wholly unsuspected conditions in the upper atmosprere. The records generally were tolerably satisfactory up to some 10 to 12 kilometers—satisfactory, because through at least the upper half of this region they showed the temperature to decrease with elevation at, very roughly, the adiabatic rate for dry air. But somewhere in the neighborhood of 11 kilometers elevation everything seemed to go wrong, for from here on the records no

longer indicated a decrease of temperature with increase of elevation, but often even a slight increase! There were but two possible conclusions. Either the apparatus had developed, in actual use, faults that the cross questioning of the laboratory had failed to reveal, or else the upper atmosphere really was in a most unorthodox thermal state. However, numerous records obtained with sounding balloons at different places, by different people and with different apparatus all showed the same thing, namely, that the temperature of the upper atmosphere, though varying slightly from day to day, is, at any given time, substantially the same at all levels, as illustrated by Fig. 1.

Here, then, was a conflict between observational evidence and tradition. Actual measurements had declared the upper atmosphere to be essentially isothermal—declared it in the face of a tradition to the effect that the temperature of the atmosphere must steadily decrease to, or very nearly to, the absolute zero. The name of the joker who first perpetrated this scientific hoax may be lost to fame, but the worst of it is we physicists thoughtlessly perpetuated it. The qualification, thoughtlessly, is used advisedly, for it seems impossible than any process of reasoning could have led to such an erroneous conclusion. If the surface temperature of the earth is maintained, as we know it is, by the absorption of solar radiation, it is equally certain that in turn the temperatures of objects in the full flood of the necessarily equivalent terrestrial radiation can not drop to zero; nor, therefore, can the air, generally, cool by convection to a lower temperature than that which this radiation can maintain. These ideas, so simple that they seem hardly worth expressing, embody the fundamental explanation of why the upper atmosphere is essentially isothermal.

In addition to being exposed all the time to earth radiation the upper air is also exposed much of the time to solar radiation, but there is abundant evidence that the atmosphere at all levels is far more absorptive of the relatively long wave-length terrestrial radiation than of the much shorter wave-length solar radiation. Hence in computing from *á priori* considerations the probable temperature of the isothermal region, or stratosphere, as it generally is called, it is sufficient, as a first approximation, to consider the effect of only the outgoing radiation, which, according to the work of Abbot and Fowle, of the Smithsonian Institution, is approximately equal in quantity and kind to that which would be emitted by a black surface coincident with the surface of the earth and at the temperature of 259° A. As a further simplification the surface in question may be regarded as horizontal and of infinite length and breadth in comparison to any elevation attained by sounding balloons, and, therefore, as giving radiation of equal intensity at all available altitudes.

Now consider two such surfaces, parallel and directly facing each other at a distance apart small in comparison to their width, and having the absolute temperature T_2, and let an object of any kind whatever be placed at the center of the practically enclosed space. Obviously, according to the laws of radiation, the final temperature of the object in question will also be approximately T_2. If, now, one of the parallel planes should be removed the uncovered object would be in substantially the same situation, so far as exposure to radiation is concerned, as is the atmosphere of the isothermal region in its exposure to radiation from the lower atmosphere. Of course each particle of the upper air receives some radiation from the adjacent atmosphere, but this is small in comparison to that from lower levels and may, therefore, provisionally be neglected. Hence the problem, as an approximation, is to find the temperature to which an object, assumed infinitesimally small, to fit the case of a gas, will come when exposed to the radiation of a single black plane at a given temperature, and of infinite extent.

But whether an object lies between two planes of equal temperature, as above assumed, or, like the upper air, faces but one,

it clearly is in temperature equilibrium when and only when it loses as much energy by radiation as it gains by absorption. Furthermore, so long as its chemical nature remains the same its coefficient of absorption is but little affected by even considerable changes of temperature. Therefore, whatever the nature of the object, since it is exposed to twice as much radiation when between the two planes as it is when facing but one, it must, in the former case, both absorb and emit twice as much energy as in the latter. That is,

$$E_2 = 2E_1$$

in which E_2 and E_1 are the quantities of heat radiated by the object per second, say, when between two planes and when facing but one, respectively.

Again,

$$E_2 = K_2T_2^{n_2}$$

and

$$E_1 = K_1T_1^{n_1}$$

in which T_2 and T_1 are the respective absolute temperatures of the object under the given conditions, and K and n its radiation constants.

For every substance there are definite values of K and n which, so long as the chemical nature of the object remains the same, do not rapidly vary with change of temperature. Hence, assuming $K_2 = K_1$ and $n_2 = n_1$, it follows, from the above equation

$$E_2 = 2E_1,$$

that

$$T_2 = T_1\sqrt[n]{2}.$$

From this it appears that there must be some temperature T_1 below which the radiation of the earth and lower atmosphere will not permit the upper atmosphere to cool, though what it is for a given value of T_2 depends upon the value of n.

But as already explained the value of T_2 is roughly 259° A., and if $n = 4$, the value for a full radiator, it follows that

$$T_1 = 218° \text{ A.},$$

substantially the value found by observation.

STORM EFFECTS ON TEMPERATURE GRADIENTS

Another surprising and, for a time, disconcerting contribution of the sounding balloon to our knowledge of the air relates to the relation of the temperature of the atmosphere to storm conditions. It has long been known that, in general, areas of low pressure—cyclonic areas—are accompanied by inwardly spiralling winds and precipitation; and, conversely, that areas of high pressure—anticyclonic areas—are characterized by outwardly spiralling winds and clear skies. Certainly, then, the inwardly flowing winds of the cyclone must ascend, and the outwardly flowing winds of the anticyclone must be sustained by descending currents. And the next inference, namely, that the air of the cyclone is relatively warm and the air of the anticyclone comparatively cold, seemed equally certain; for, indeed, what else could cause ascent in the one case and descent in the other? But again the facts are not in accord with the simplest and most obvious inference, but just the reverse, through all convective levels, that is, up to the base of the stratosphere, as shown by Figs. 2 and 3, except, in general, near the surface, during the winter. In short, quite contrary to familiar ideas about convection, the ascending air in this case is relatively cold and the descending air comparatively warm. And the stratosphere, as these figures also show, but further confounds this confusion, for here the temperature relations are again reversed, the warmer air being now over cyclones and the colder, above anticyclones.

The facts just stated were, indeed, for a time somewhat disconcerting, but they have helped to the realization that with reference to temperature there are two classes of extratropical cyclones, cold (migratory) and warm (stationary); and also two classes of anticyclones, warm (migratory) and cold (stationary).

That the atmosphere of a stationary anticyclone should average relatively cold, and that of the cyclone comparatively warm, is obvious from the fact that the former occurs only

over cold areas, such as Greenland, Antarctica, etc., and the latter over regions that are warm in comparison with neighboring areas, such as the water southeast of Greenland, the Gulf of Alaska (in the winter), etc. All such cases are readily explained on the principle of thermal convection, and therefore offer nothing new.

The migratory storms, however, at least those of middle latitudes, are quite different. The relation of their temperatures to each other, level for level up to the stratosphere, is just the reverse of that which it would have to be if their circulations were of immediate thermal origin. Presumably, therefore, their circulations are largely driven and their temperatures in part mechanically determined.

As every one knows, the temperature contrast between the regions of low and high latitudes, respectively, leads to an interzonal circulation of the atmosphere. And because of the rotation of the earth this circulation

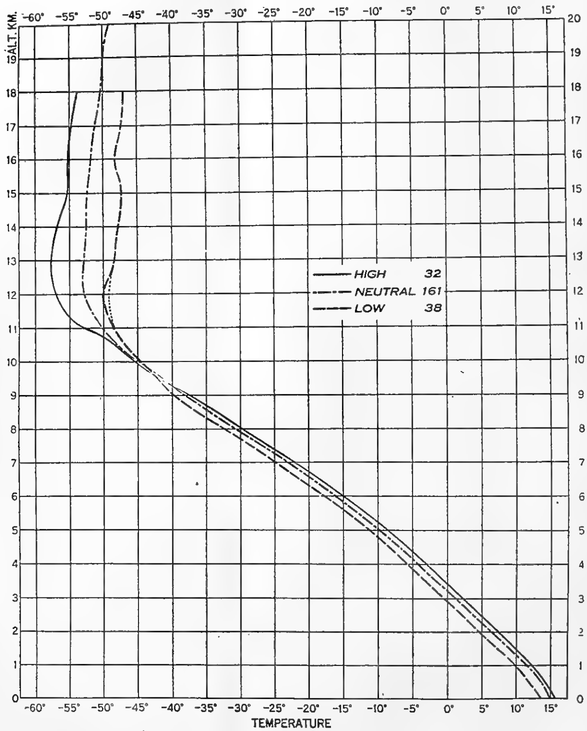

Fig. 2. Relation of summer temperatures to barometric pressure.

becomes, through a portion of its course, the prevailing winds from the west, that up to near the base of the stratosphere average stronger, and are more nearly constant in direction, with increase of altitude. Now, whatever the origin of the migratory anticy-

clone, a subject that still requires further investigation, one of its chief features is deep winds from higher latitudes in its eastern portions. These winds, because of the rotation of the earth, necessarily lose more or less of such west-to-east velocity as they previously surface up to near the base of the stratosphere. This increase of pressure in turn forces the loaded air to descend, warming on the way according to the adiabatic gradient of 1° C. per 103 meters (if free from clouds) and thereby raising the temperature at all levels

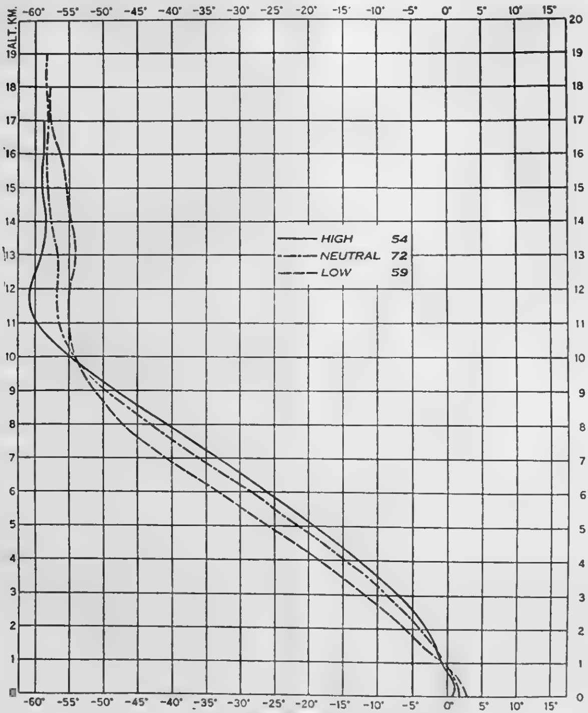

Fig. 3. Relation of winter temperatures to barometric pressure.

may have had. They lag in the midst of the general circulation. Hence the prevailing westerlies flow over them as over a mountain barrier. But by this overflow the westerlies produce at least three different effects: (*a*) They load the atmosphere over which they pass, and thus increase the pressure from the through which it passes. (*b*) They bodily lift the stratosphere whose pressure thereupon tends to decrease at every level in proportion to the initial pressure at that level—a result that would produce dynamically an equal drop in temperature throughout the stratosphere. (*c*) By their own dynamical cooling, and at

least until the pressure of the upper atmosphere has become readjusted, they establish at the base of the stratosphere a layer of minimum temperature.

These conclusions are in full accord with Figs. 2 and 3.

Similarly, whatever the origin of the migratory cyclone, another of the many meteorological problems that needs further investigation, one of its chief features is a deep wind in its eastern portions from lower to higher latitudes. In this case the rotation of the earth leads to a speeding up of the eastward component of the velocity. Hence this air may be expected to run forward and up and thus to produce a low pressure to its rear. Because of the upward trend thus given to much of the air in the cyclone that portion of it below the stratosphere is more or less dynamically cooled. At the same time the stratosphere bodily drops to lower levels wherever air has been removed from beneath it. Hence its pressure is increased at every level in proportion to the initial pressure at that level and its temperature thereby raised by an equal amount throughout.

Radiation and absorption probably also have some part in determining the temperature conditions and interrelations of migrant cyclones and anticyclones, but the chief cause appears to be purely mechanical, as above explained.

THE LAW OF WIND-INCREASE WITH ELEVATION

The fact that wind-velocity generally increases with elevation has long been known, but the law of this increase was not formulated for any levels until only a few years ago, nor the cause back of this law revealed until still more recently. The law in question applies only to that portion of the atmosphere that lies between the elevations of 3 to 4 and 8 to 9 kilometers. Nor could it in any modified form be satisfactorily extended to other levels—not much below 3 kilometers, because of the irregular disturbances due to surface friction, innumerable barriers, and convectional turbulence; nor much beyond 9 kilometers, because not far from this level the vertical temperature gradient, upon which the winds largely depend, rather abruptly and greatly changes. The form of this law, that applies as a first approximation to so much of the atmosphere, is very simple. It says merely that the velocity of the wind varies inversely with its density, or, in other words, that the mass-flow is a constant. This was determined empirically first by Clayton, of this country, who hid his discovery in a journal of small circulation; and subsequently by Egnell of France, whose proper publication won for the same discovery the appreciative name Egnell's law.

To show the rationale of this law it is convenient to assume the well known fact that the velocity of a steady wind half a kilometer or more above the surface and thus nearly frictionless, is given approximately (neglecting the generally small deflective force due to cyclonic motion) by the equation

$$V=\frac{G}{\rho 2\omega \sin\phi}$$

in which G is the horizontal pressure gradient, or difference in pressure per unit distance normal, horizontally, to the local isobar, ρ the density of the air, ω the angular velocity of the earth's rotation and ϕ the latitude. From this equation it follows at once that at any place, the mass-flow, ρv, is directly proportional to the horizontal pressure gradient. Hence to find the relation of mass-flow to elevation it is sufficient to determine the relation of horizontal pressure gradient to elevation.

Consider, then, two adjacent columns of air initially exactly alike, and let the temperature of one be increased over that of the other by the same amount throughout. Each isobaric level in the warmed column will thereby be raised in direct proportion to its original height, and the horizontal pressure thus established at each height h will be proportional to the product of this lift by the local density. That is

$$\frac{G}{G'}=\frac{h\rho}{h'\rho'}.$$

But from the height of 3 or 4 kilometers above sea level up to that of 8 or 9, the density of the atmosphere is roughly inversely propor-

tional to the altitude. Hence, to this same crude approximation, G is also constant through the given range of levels.

Now the actual temperature distributions in the atmosphere at different latitudes are essentially as assumed in the two adjacent columns. Hence the horizontal gradient and therefore the mass-flow, ρv, must be roughly constant between the given limiting levels; or, as usually stated, the velocity of the wind inversely proportional to its density.

W. T. Humphreys

(*To be continued*)

SCIENTIFIC EVENTS

MEMORIAL TO LEWIS HENRY MORGAN

Temporarily displayed in Memorial Hall, at the American Museum of Natural History, New York, is a bronze tablet commemorating the one hundredth anniversary of the birth of Lewis Henry Morgan, called the father of American anthropology. The tablet embodies an Iroquois Indian decorative motif and a wampum record of the founding of the "Iroquois League." After being exhibited at the American Museum, the tablet will be sent to Wells College, where it will be permanently installed.

Morgan was born in Aurora, New York, in 1818, and died in 1881 at Rochester. He graduated from Union College in 1840, and was admitted to the New York bar in 1842. In 1855, his interest in certain rich iron deposits led him to make practical explorations into northern Michigan, at that time a wilderness. Here he became interested in the habits and labors of the beaver, and after several years of observation and study wrote his "American Beaver and His Works," which is still considered the most authentic book of its kind.

Early in his life, Mr. Morgan had become a member of a secret society known as the Gordian Knot. This society was accustomed to meet on the ground of the ancient confederacy of the "five nations," holding its council fires at night on the former lands of the Mohawks, Oneidas, Onondages, Cayugas and Senecas. Gradually its members developed a curiosity about the history, institutions and government of the Indians, and began to gather together odd scraps of information about them. Mr. Morgan's interest became so strong that he devoted himself to serious study of the subject. He wrote a number of papers which were read before the New York Historical Society and elsewhere, and some of which were published in book form in 1851 under the title of "The League of the Iroquois," in which the social organiation and government of the confederacy were thoroughly explained, the first scientific account of an Indian tribe. He later wrote a number of books and papers on Indian life, and gathered together a library containing many important works on American ethnology. For the purpose of studying the Six Nations, he organized the Grand Order of the Iroquois. He was assisted in his researches by the Smithsonian Institution and the United States Government.

The tablet at the American Museum was designed by Mr. Gohl, of Auburn. In addition to the symbolic decorations and various facts about Mr. Morgan's life and works inscribed on the tablet, is the following quotation from his "Ancient Society": "Democracy in Government, Brotherhood in Society, Equality in Rights and Privileges and Universal Education foreshadow the Next Higher Plane of Society to Which Experience, Intelligence and Knowledge are Steadily Tending. It will be a Revival in a Higher Form of the Liberty, Equality and Fraternity of the Ancient Gentes."

THE BRITISH DYE INDUSTRY[1]

The works and appliances of the German firms remain substantially undiminished in extent and unimpaired as to organization, while they still possess a large body of expert chemists and engineers fully acquainted with the details of the business, though doubtless there have been serious losses in the course of the war. It is, however, satisfactory to learn from the address of Lord Armaghdale,

[1] From *Nature*.

the chairman of Levinstein's, that, in his opinion, provided sufficient financial support is forthcoming, this country may be rendered independent of German dyestuffs. On the scientific side, he added, success is certain. There is in this country a larger amount of chemical talent than has hitherto been recognized, and during the war many university professors and others occupied with purely scientific research have given valuable assistance to the color industry, as well as in other departments of manufacture.

Considering the difficulties to be overcome in the revival of chemical industries in this country at the beginning of the war, and, as compared with Germany, the serious lack of organization and of scientifically trained assistance, the success so far achieved is encouraging in the highest degree. There is no justification for the gloomy view of the situation sometimes taken, and if the scheme now working under the Board of Trade is not perfect, it is, at any rate, a step in the right direction, and has been accepted by the dye-makers and the dye-users.

The trade and licensing committee referred to in the scheme has now been constituted under Lord Colwyn as chairman. The following are the other members: Mr. Henry Allen, Mr. Milton Sharp and Mr. Lennox B. Lee, nominated by the Color Users' Committee; Mr. T. Taylor, representing the paint and varnish manufacturers; Dr. Herbert Levinstein and Mr. J. Turner, nominated jointly by British Dyes, Ltd., and Levinstein's, Ltd.; Mr. W. J. Uglow Woolcock, M. P., nominated by the Association of British Chemical Manufacturers; and Mr. W. H. Dawson, nominated by the president of the Board of Trade. The commissioner for dyes, Sir Evan Jones, M.P., will be an *ex officio* member without a vote. Dr. H. Levinstein is the well-known managing director of Levinstein's, Ltd., and he will control the scientific and manufacturing operations of the new corporation resulting from the fusion of British Dyes and Levinstein's. Mr. J. Turner has been a director of British Dyes, Ltd., for several years, and he will be largely influential in the business arrangements of the conjoint firms.

The functions of the committee now constituted will be to determine the colors and intermediates which shall be licensed for import into the United Kingdom after the conclusion of peace, and to advise the Commissioner for Dyes as to the colors and intermediates the manufacture of which in this country should be specially encouraged.

It is satisfactory to find that the Port Ellesmere indigo factory has been in full work for some time, and that land has been secured for considerable extensions of the works in the near future.

DISTRIBUTION OF THE MEMBERSHIP OF THE AMERICAN CHEMICAL SOCIETY

The membership of the American Chemical Society was 12,203 at the end of the year 1918, having increased 1,600 during the year. The sections of the society and the number of members not in arrears on November 30, 1917 and 1918 were as follows:

Local Section	1917	1918
Alabama	52	111
Ames	34	19
California	292	294
Central Texas	59	42
Chicago	649	627
Cincinnati	165	180
Cleveland	278	319
Columbus	97	101
Connecticut Valley	109	98
Cornell	39	35
Delaware	...	268
Detroit	102	105
Eastern New York	72	85
Georgia	76	73
Indiana	157	157
Iowa	62	75
Kansas City	155	141
Lehigh Valley	94	98
Lexington	22	23
Louisiana	59	64
Louisville	19	20
Maine	53	55
Maryland	142	211
Michigan Agricultural College	31	24
Milwaukee	95	97
Minnesota	121	121
Nashville	26	26

Nebraska	48	52
New Haven	70	82
New York	1,594	1,799
North Carolina	40	43
Northeastern	633	664
Northern-Intermountain	17	23
Oregon	35	33
Philadelphia	737	716
Pittsburgh	401	441
Puget Sound	76	91
Rhode Island	85	92
Rochester	56	52
St. Louis	149	160
Southeast Texas	43	38
Southern California	157	183
South Carolina	24	26
South Dakota	29	21
Syracuse	149	127
Toledo	43	46
University of Illinois	115	106
University of Michigan	47	34
University of Missouri	14	12
Vermont	28	18
Virginia	97	111
Washington, D. C.	402	578
Western New York	181	202
Wisconsin	93	95
	8,423	9,166

SCIENTIFIC NOTES AND NEWS

THE gold medal of the National Institute of Social Sciences has been awarded to Dr. Wm. H. Welch, of the Johns Hopkins Medical School.

DR. HENRY A. BUMSTEAD, professor of physics at Yale University, has returned from France, having been engaged in war work abroad since 1917.

DR. LAFAYETTE B. MENDEL, professor of physiological chemistry in Yale University, who has been overseas as a representative of the U. S. Food Administration on the Inter-Allied Scientific Food Commission, has returned to the United States.

MAJOR GENERAL WILLIAM C. GORGAS, U. S. Army, retired, will return from Guatemala to Washington, D. C., in February, and on his return to South America in the spring will be accompanied by Mrs. Gorgas.

COLONEL G. A. BURRELL, of the Chemical Warfare Service, returned to private chemical engineering work at Pittsburgh in January. He was called to Washington by the Bureau of Mines early in the war, to take charge of the research organization that later became the American University Experiment Station of the Chemical Warfare Service.

AT the recent meeting of the Mathematical Association of America Professor Herbert Ellsworth Slaught, of the University of Chicago, was elected president.

FRED RASMUSSEN, professor of dairy husbandry, The Pennsylvania State College, State College, Pa., was, on January 21, 1919, appointed secretary of agriculture for the state of Pennsylvania and left immediately to take up his new duties at Harrisburg.

CARL N. AUSTIN, who went from the Sears-Roebuck laboratories with a commission as first lieutenant in Gas Defense, has recently been appointed director of the First Corps Gas School located at Gondrecourt, Meuse, France.

LIEUTENANT JOHN P. TRICKEY, a member of the Chicago Section of the American Chemical Society, has been promoted to a captaincy in the Chemical Warfare Service, and is on duty in France.

DR. KEIVIN BURNS, of the division of optics, Bureau of Standards, is absent on an extended trip abroad in connection with his scientific work.

THE Geological Society, London, has made its awards as follows: Wollaston medal, Sir Aubrey Strahan, director of the British Geological Survey; Murchison medal, Miss Gertrude L. Elles, Newnham College, Cambridge; Lyell medal, Dr. W. F. Hume, director of the Geological Survey of Egypt; Bigsby medal, Sir Douglas Mawson; Wollaston fund, Dr. Alexander Logie Du Toit, Geological Survey of South Africa; Murchison fund, Mrs. Eleanor M. Reid; Lyell fund, Mr. John Pringle, Geological Survey of England and Wales, and Dr. Stanley Smith, University College, Aberystwyth.

The following committees have been named by the president of the American Chemical Society:

1. Committee to Cooperate with the Society for the Promotion of Engineering Education on Educational Problems: H. P. Talbot, R. H. McKee, S. W. Parr.

2. Committee on Publication of Compendia of Chemical Literature: Julius Stieglitz, John Johnston, E. C. Franklin, J. C. Olsen, James Kendall.

3. Committee to Consider Allocation of Federal Grants for Scientific and Industrial Research: W. R. Whitney, C. L. Alsberg, John Johnston, W. D. Bigelow, Wm. McPherson.

4. Committee to Formulate a Method of Cooperation with the National Research Council: W. D. Bancroft, Atherton Seidell, W. F. Hillebrand, F. G. Cottrell, C. L. Parsons.

5. Committee on Coordination of Chemical Work within the War Department: C. H. Herty, E. P. Kohler, H. P. Talbot, John Johnston.

6. Omnibus Committee for Spring Meeting: A. D. Little, B. C. Hesse, F. M. Dorsey, T. B. Wagner, R. F. Bacon, C. G. Derick, L. C. Drefahl.

We learn from the *Journal* of the American Medical Association that a health commission of the Allies has been formed containing representatives of most of the large nations allied against Germany. A subcommission was recently appointed by Professor Santoliquido, delegate from Italy, and president of the commission. The subcommission will meet in Paris on the first or fifteenth of each month to consider the most important sanitary problems regarding demobilization, the occupation of territory formerly invaded, the military occupation of enemy territory as related not only to the health of the troops, but also to the civilians concerned. The personnel of the subcommission is: president M. le Professeur Santoliquido, Conseiller d'Etat Délégué de l'Italie dans le Comité de l'Office International d'Hygiène publique; M. le Médecin Principal de premiere Class Maistriau, Commandant du Groupement Régional du Service de Santé à Rouen; M. le Médecin Général Jan; M. le Col. Richard P. Strong, Director Department of Medical Research and Intelligence, A. R. C., M. le Col. W. W. O. Beveridge, C.B., D.S.O., Assistant Director of Medical Services for Sanitation, Professor of Hygiene Royal Army Medical College; M. le Médecin Major Levi; M. Coussol; M. de Lieutenant Colonel Médecin Professeur A. Castellani; M. de Cazotte, Ministre Plénipotentaire, Director de l'Office International d'Hygiéne publique; M. le Docteur Pottevin, Directeur Adjoint.

Promotions in, and appointments to, the Civil Division of the Order of the British Empire for services in connection with the war were published on January 9. The list includes five Knights Grand Cross of the Order (G.B.E.), six Dames Grand Cross (G.B.E.), forty-nine Knights Commanders (K.B.E.), one hundred and seventy-eight Commanders (C.B.E.), and five hundred and thirty Officers (O.B.E.). *Nature* selects the following names of men known in scientific circles: *K.B.E.:* W. J. Pope, FR.S., professor of chemistry, University of Cambridge; Aubrey Strahan, F.R.S., director of the Geological Survey of Great Britain; Cecil L. Budd, Non-ferrous Metals Department, Ministry of Munitions; and W. J. Jones, Iron and Steel Production Department, Ministry of Munitions. *C.B.E.:* J. W. Cobb, Livesey professor of coal, gas and fuel industries, University of Leeds; H. H. Dale, F.R.S., director of pharmacology and chemotherapy under the Medical Research Committee; A. Eichholz, senior assistant medical officer, Board of Education; J. C. M. Garnett, principal, Municipal College of Technology, Manchester; Lieutenant Colonel R. J. Harvey-Gibson, professor of botany, University of Liverpool; and P. Chalmers Mitchell, F.R.S., secretary of the Zoological Society of London. *O.B.E.:* J. B. Bailie, professor of philosophy, University of Aberdeen; W. Foord-Kelcey, professor of mathematics and mechanics, Royal Military Academy; and W. E. S. Turner, head of the department of glass technology, University of Sheffield.

In the course of lectures of the Chicago Academy of Sciences dealing with problems of reconstruction, one on "Scientific Leadership of the World" was given by Professor

Henry Crew, Northwestern University, on February 14. On March 21 in the series of lectures on Swedish Contributions to Science which are to be given under the auspices of the Swedish Study League in cooperation with the Chicago Academy of Sciences, Professor Crew will speak on "Swedish Contributions to the Science of Physics."

A course of nine lectures on dynamical meteorology is being given at the Meteorological Office, London, by Sir Napier Shaw, reader in meteorology in the University of London. Each lecture is followed by a conversational class. The informal meetings at the Meteorological Office for the discussion of important current contributions to meteorology, chiefly in colonial or foreign journals, will be resumed on April 28.

On January 15, Dr. George T. Moore, director of the Missouri Botanical Garden, spoke before the St. Louis Natural History Museum Association at the Public Library, on "The Educational Value of the Missouri Botanical Garden."

Efforts are being made to establish a chair of mathematical physics at the University of Edinburgh in memory of the late Professor Tait.

Dr. Clarence John Blake, Walter Augustus Lecompte professor of otology, emeritus, in the Harvard Medical School, died at his home in Boston on January 29, in the seventy-sixth year of his age.

We learn from the *Journal* of the Washington Academy of Sciences of the death of Captain Howard E. Ames, medical director, U. S. N., retired, who died on December 27, 1918. Dr. Ames had been an officer in the Navy since 1875, and had been on the retired list since 1912. He served as medical officer on board the *Bear*, which rescued General Greely and his party in the Arctic regions. He was a member of the Biological Society.

We learn from *Nature* that Casimir De Candolle, died on October 3, 1918, at Geneva, where he was born in 1836, and where the greater part of his life had been spent. Casimir De Candolle made valuable additions to the sum of botanical knowledge, though his work was not of such fundamental importance as that of his father, Alphonse, and grandfather, Augustin.

Mr. Andrew Braid, hydrographic and geodetic engineer of the U. S. Coast and Geodetic Survey, and chairman of the U. S. Geographic Board, has died in his seventy-third year.

Dr. Gabriel Marcus Green, instructor in mathematics in Harvard University, died in Cambridge on January 24, in the twenty-eighth year of his age.

Dr. W. Marshall Watts, who while engaged as a science teacher in an English school carried on valuable work on spectroscopy, died on January 13, at the age of seventy-four years.

The *Journal* of the American Medical Association reports the following deaths from influenza in Brazil: Dr. T. Bayma, the distinguished physician and bacteriologist of S. Paulo, director of the bacteriologic and the vaccine institutes there, aged fifty-five; Dr. Santos Moreira, a leading pediatrist of Rio de Janeiro, director of the *Medicina Clinica*, and Dr. Paulo Silva Araujo, a leading microbiologist, who published in 1915 his "Vaccine Therapy of Bronchial Asthma."

The American Chemical Society will hold its spring meeting at Buffalo beginning on the morning of April 8.

It is announced that Genera Insectorum, the great work describing all the genera of insects, published at Brussels, is to be continued. When the country was invaded in 1914, several parts were about to be published; these are to appear in 1919. The stock of the previously published parts was saved, and is now available.

The laboratory of forest pathology of the Bureau of Plant Industry, U. S. D. A., Dr. James R. Weir in charge, has been removed from Missoula, Montana, to Spokane, Washington, where it will be permanently installed in a fireproof building. The most intensive work of this laboratory is centered in the great white pine forests of Idaho. To promote pathological investigation in this region, a

permanent field station will be established; also a forest pathological museum. All future communications should be addressed to Laboratory of Forest Pathology, Spokane, Washington.

Reasons for continuing the Chemical Warfare Service as a permanent branch of the War Department were presented to the House Committee on Appropriations by General Wm. L. Sibert. In part, he said: "An organization of this kind would have as its biggest element a research branch, the function of which branch would be to keep abreast of the times in all of the chemical appliances or substances necessary or useful in war and, if the use of gas is continued or authorized, the training of troops in the use of gas masks and things of that sort. That would be a part of its functions, but whether gas is used or not there are other chemical substances, such as smokes, that have a tactical use in warfare and the use of which is growing. I refer to the making of screens behind which troops can advance. We would also have a proving ground force in connection with our research force to try out appliances that were developed either in our own laboratories or found abroad."

The American Museum will continue its Second Asiatic Zoological Expedition for another year. The first expedition sailed from the United States in March, 1916, and the second in June, 1918, both under the leadership of Mr. Roy C. Andrews, of the department of mammalogy. So far Mr. Andrews has canvassed especially the Chino-Tibetan border and western tropical China as far as Burma. He is at present in Peking and proposes, as soon as the spring weather arrives, to proceed to Urga in northern Mongolia. This town is situated near the junction of two life zones, the Siberian and the Mongolian and Central Asian. In this region Mr. Andrews expects to take moose, elk, wild boar and other large game. After a four months' stay in northern Mongolia, he hopes to hunt big-horn sheep along the Chino-Mongolian frontier. The species of mountain sheep found here is large, with horns measuring sixty inches. In following out the present program the expedition plans to be back in New York some time in February, 1920.

First Lieutenant Tracy I. Storer, Sanitary Corps, has been discharged from military service and has returned to his former position at the museum of vertebrate zoology at the University of California after an absence of sixteen months.

Mr. H. F. Staley, formerly professor of ceramic engineering at Iowa State College, joined the staff of the Bureau of Standards in December as metallurgical ceramist.

The bureau of economic geology and technology of the University of Texas will cooperate with the United States Geological Survey in making explorations for potash in the western part of the state. Orby C. Wheeler has been engaged to take charge of the work.

Professor Fred W. Ashton has been granted a leave of absence by the University of the Philippines and has taken over new duties as carbonization supervisor with the Chemical Warfare Service at Manila, P. I.

Mr. H. C. Raven, of the Smithsonian Institution, has returned to Washington from the island of Celebes, and has gone to Cornell University to continue his studies. Mr. Raven has collected in the East Indies during the last six years more than four thousand mammals and five thousand birds for the National Museum.

Henry Schmitz, Rufus J. Lackland fellow in the Missouri Botanical Garden, who has been in the Naval Reserves since the beginning of the war, has returned to resume his work at the Garden.

Nature states that Sir Lazarus Fletcher will retire from the directorship of the Natural History Museum, under the age limit, on March 31. The office was made in 1856, under the style of superintendent of the Natural History Departments, so that the trustees of the British Museum might obtain the services of Sir Richard Owen, who supervised the planing of the new mueum at South Kensington, and retired shortly after its com-

pletion in 1884. Under the style of director, Sir William Flower succeeded Sir Richard Owen, and he retired in 1898. For the next decade Sir E. Ray Lankester was director, and he was followed by Sir Lazarus Fletcher early in 1910.

DR. J. D. FALCONER, lecturer in geography in Glasgow University, has been granted further leave of absence in order that he may act at the first director of the Geological Survey of Nigeria.

UNIVERSITY AND EDUCATIONAL NEWS

A GIFT of $50,000 from Lieutenant Howard H. Spaulding, has been made for the physiological laboratory building fund of Yale University. The principle of this fund may be used by the university at any time in its discretion for the construction of a physiological laboratory and meanwhile the income is to be used annually in meeting the expenses of the department of physiology.

MR. GEORGE BONAR, president of the Dundee Chamber of Commerce, has given £25,000 for commercial education in University College, Dundee.

THE Royal Edinburgh Asylum for the Insane has offered an endowment of £10,000 towards a chair of mental diseases in the University of Edinburgh.

PLANS for the introduction of a course on public health and industrial medicine in the college of medicine of the university of Cincinnati are being made by Dean C. R. Holmes. The course has the support of the United States Public Health Service and it is planned to conduct it on the cooperative basis somewhat like that used in the college of engineering.

PROFESSOR HAL W. MOSELEY has been promoted to be associate professor of chemistry in Tulane University, New Orleans, La.

PROFESSOR E. O. HEUSE, formerly instructor in physical chemistry at the University of Illinois, and later professor of chemistry at Monmouth College, Monmouth, Ill., has been appointed professor of chemistry and head of the department at Southern Methodist University, Dallas, Texas.

DISCUSSION AND CORRESPONDENCE

APPLIED PSYCHOLOGY

TO THE EDITOR OF SCIENCE: At the close of his interesting address on "Scientific Personnel Work in the Army," Professor Thorndike remarks: "Making psychology for business or industry or the army is harder than making psychology for other psychologists, and intrinsically requires higher talents." It is well that a man should believe whole-heartedly in his own work and magnify it accordingly. But it is a pity to draw comparisons of this sort.

Reduced to its lowest terms, Professor Thorndike's question is: Which is the harder taskmaster, one's employer or one's conscience? And he decides unequivocally in favor of the employer. I should rather say: It depends! For Professor Thorndike, the employer is a creature of iron, who demands an adequate solution of a given problem by a fixed and early date, and who has no grain of sympathy with unsuccessful work and the unsuccessful worker. It is possible, however, that the employer might extend the date: even if he had not the good will, he might be obliged to. It is possible also that he might sympathize with the unsuccessful work, enter into it, and find in it something worthy of commendation and even of publication. Conscience, on the other hand, is for Professor Thorndike an easy mistress; she allows you yourself to ask the questions for which you proceed to find answers. That sort of conscience seems to me to pertain to the dilettante rather than to the man of science. To the scientific investigator the whole front of his science is one great problem, and he plunges in where the obscurity is thickest. He may hesitate between two or three calls: experimental psychologists have, in recent years, been divided on the question whether the problem of perception or the problem of thought is the more insistent: but Professor Thorn-

dike's notion of "ten thousand" possible directions of activity is pure illusion.

The relations of pure and applied science—not that I like those terms—are extraordinarily complex. No one, so far as I know, has ever worked them out with the fulness the subject deserves. It lies on the surface, however, that applied science furnishes its counterpart with a vast number of appliances and procedures which represent standardizations and short-cuts of method, and that pure science on its side furnishes applied science with ideas. If anyone doubts the latter part of this statement, I refer him to the address by my colleague, Professor Nichols, printed in SCIENCE of January 1, 1909. There are, in point of fact, all manner of mutual dependences and mutual relations, and there is no clean-cut antithesis of conscience and employer.

I believe very strenuously in pure science. But I think I see that there is no end of work to be done on both sides of the line that Professor Thorndike draws. I wish him more power to his elbow; and I wish him graduate students as talented, ingenious, adaptable and persistent as our colleges can provide. Only I think it foolish to tell these students how superior they are to their fellow-students in the other field: because—apart from the question of fact—they will do better work in a spirit of humility. Surely there is enough downright, sweating labor for all of us, and surely it is waste of time to argue about priority of talent.

E. B. TITCHENER

THE PUBLICATION OF ISIS

TO THE EDITOR OF SCIENCE: The publication of *Isis,* an international quarterly devoted to the history and philosophy of science, was brutally interrupted in 1914 by the German invasion of Belgium. As I have no direct way of reaching all those who at that time had subscribed to Volumes II. and III., I would be grateful to you if you would kindly insert this account of the future projects of the journal.

The sixth part of *Isis* was in the press in Brussels when war broke out. It will appear as soon as circumstances permit, but I fear this will not be until next autumn. The publication of Volume III., however, will take place soon after, perhaps in 1919, but at the latest in the early part of 1920. The undertaking in its original form met with encouraging support from many quarters; I may be permitted to mention for example that it is for my work in connection with it that the Prix Binoux was awarded to me by the Académie des Sciences of Paris in December, 1915. Yet after four years of work and thought the weaknesses of *Isis* are very obvious to me and I shall endeavor to correct them. Of course, the latter part of Volume II., as well as Volume III., which had already been prepared for publication in 1914, will not greatly differ from Volume I. But from Volume IV. onward considerable changes will be made. It is my ambition to make *Isis* the main center of information in all matters pertaining to the history and philosophy of science and the international organ of New Humanism.[1]

Some of the features which I propose to introduce are as follows:

Instead of publishing in four languages an effort will be made to use only French and English—chiefly, and perhaps exclusively, the latter. Articles written in other languages will be translated into English. More illustrations will be added and will consist mainly of portraits, facsimiles of manuscripts and of rare books. The bibliographical section will contain a larger number of short critical notes. Moreover, from Volume III. or IV. onward I hope to share the editorial responsibilities with other scientists, chiefly with Dr. Charles Singer, of Exeter College, Oxford, who is known as a historian of medicine and a medieval scholar.

The new *Isis* will only publish shorter articles. The longer and more monographic ones would be included in Singer's *Studies in the*

[1] Those who are not already acquainted with this movement to humanize science and to show its relationship to all other aspects of human life and thought, will find an explanation of it in *Scientia,* Bologna, March, 1918, or in the *Scientific Monthly,* New York, September, 1918.

History and Method of Science. The first volume of this work was issued by the Oxford University Press in 1917. I understand that the second volume is now ready for the press and Dr. Singer tells me that he hopes to share with me the editorial responsibilities of the third and succeeding volumes. Thus, *Isis* and the *Studies* would be supplementary one to the other, and between them would provide suitable outlet for new work on the history and philosophy of science.

GEORGE SARTON

CARNEGIE INSTITUTION OF WASHINGTON

A STEADY CALENDAR

TO THE EDITOR OF SCIENCE: The interruption of our recent scientific meetings by the coming of Sunday in the middle of the (Christmas) week—a reputed impossibility that happens every five or six years—is one of the many inconveniences that we half-consciously endure as the result of inheriting a varying calendar from the unscientific past. If in adopting any one of the many improved calendars that have been proposed, we should annually sacrifice upon the altar of reason a single day in ordinary years and two days in leap years, as extra days without week-day names, then Christmas and New Years would always fall on the same day of the week; and by waiting to begin the sacrifice until those holidays come on a Saturday or a Monday, the scientific meetings of the last five days of the year, which have become so well established among us, would never thereafter be broken in half by an interrupting Sunday. Home celebrations and scientific meetings would both profit by the change. How can we best bring it about?

W. M. DAVIS

CAMBRIDGE, MASS.,
January 4, 1919

SCIENTIFIC BOOKS

Forced Movements, Tropisms and Animal Conduct. By J. LOEB. Philadelphia. 1918. Pp. 209, 42 figs.

The scope and character of this volume are in large part explained by the fact that it is offered as one of a series of monographs in which it is proposed to cover the field of recent developments in biology. The announced titles of the volumes scheduled to follow this first number deal, not so much with rational divisions of the science, as with those particular phases of physiology that have been the subjects of investigation at the hands of the respective writers. This general plan, already justified by its success in the treatment of modern advances in physical and biological chemistry, and in human physiology, necessarily results in a less closely coordinated system of monographs when applied to physiology proper—the latest of the sciences to acquire a realization of the analytical significance of quantitative methods of thought.

The first volume of the proposed series, then, endeavors to present within the space of some 170 pages a concise statement of the theory of tropisms, their origin in forced movements under various forms of activation, and their importance for the analysis of animal conduct, including that of *Homo.* Much of the matter discussed is, of course, no longer new; about half the content of the book is already familiar from the author's similar article in Winterstein's "Handbuch," and other publications; but as a compact, clear, and characteristically vigorous statement of the essential quantitative data upon which the tropism doctrine now rests, the book is welcome and in the main satisfying. In the introductory section it is pointed out that tropistic phenomena, depending upon the orientations of the animal as a whole, rather than the segmental reflexes, must be made the starting point for the analysis of conduct; that these tropistic orientations must first be studied in the behavior of bilateral animals; and that the key to the understanding of tropisms lies in forced movements initiated through differential tensions in symmetrical contractile elements of the body, not in the distinction of "pleasure" from "pain." It is only on such a basis, so far as we know, that quantitative laws may be deduced adequate for the description of behavior. This procedure is illustrated partic-

ularly in the discussion of phototropism, for which the experimental evidence is the most comprehensive.

Doubtless the portion of the book liable to excite the most general interest is that dealing with "Instincts" and "Memory images and tropisms." The author's views on these topics, now well known, are here incisively restated, and on some points extended. It is held that the preservative instincts are tropisms; and that the "problem of free will" is essentially solved through recognition of the orienting influence of memory images—which, being in man multitudinous, render impossible the prediction of individual behavior. The orienting powers of memory images afford an inviting topic for research, and one as yet very inadequately explored.

Two directions in which the results of tropistic analysis are of use to the naturalist are not so fully developed as one might wish: the value of determinate behavior in animals as a starting point for the experimental investigation of irritability, and the significance of the physical viewpoint for the analysis of organic phenomena as actually seen in nature. The limitations of space, however, have compelled great brevity of treatment. Nevertheless, the reader of this book should succeed in gaining fast hold of the conception that mere complexity is no bar to ultimate clarity of understanding in these matters; and should, in addition, acquire a healthy distrust toward the indiscriminate application of "laboratory results" to field conditions. The tropism doctrine, in other words, is in no sense an artificial simplification of "animal behavior." In this connection, specifically, the book will be particularly valuable as an introductory manual for students. To the investigator, already familiar with these ideas (it is to be presumed, but not in all instances correctly), the book has less new material to offer.

A bibliography of some 554 entries, not very well arranged and comprising some repetitions, together with a brief index of two and a quarter pages, complete the book. It is stated, rather bluntly, that the bibliography intentionally excludes "controversial and amateurish publications," and to that extent it should prove a useful guide. The citations are less complete for the years since 1911 than for the preceding period. No attempt has been made to critically discuss the contents of the publications listed, which is in many respects a blessing; for it is as a unitary presentation of the author's views that the monograph will be read with interest by all workers in this field.

W. J. Crozier

University of Illinois,
Chicago

THE GEOLOGICAL SOCIETY OF AMERICA

The thirty-first annual meeting of the Geological Society of America was held in the rooms of the Department of Geology, Johns Hopkins University, Baltimore, Md., on Friday and Saturday, December 27–28, 1918, under the presidency of Dr. Whitman Cross of the United States Geological Survey.

The following program was presented:

Geology as a basis of citizenship: Joseph Pogue. (Read by title.)

Sources of and tendencies in American geology: Joseph Barrell.

Geology as a synthetic science: Warren D. Smith. (Read by title.)

The United States Geological Survey as a civic institution during the war: Sidney Paige.

The military contribution of civilian engineers: George Otis Smith.

Presentation of geological information for engineering purposes: T. Wayland Vaughan.

Engineering geology in and after the war: Charles P. Berkey.

Geology in the Students Army Training Corps: Herbert E. Gregory.

Cooperation in geological instruction: Herbert E. Gregory.

Map making, map reading and physiography in the training of men for the army and navy: Wallace W. Atwood.

War work by the department of geology at the University of Oregon: Warren D. Smith. (Read by title.)

Recent earthquakes of Porto Rico: Harry F. Reid and Stephen W. Taber.

Structure of the Pacific ranges of California: Bailey Willis.

Migration of geo-synclines: Amadeus W. Grabau.

Geotectonic adaptation through retardation of the earth's rotation: CHARLES R. KEYES. (Read by title.)

Late Mississippian orogenic movements in North America: FRANCIS M. VAN TUYL and RAYMOND C. MOORE. (Read by title.)

Post-glacial uplift of the New England coastal region: HERMAN L. FAIRCHILD. (Read by title.)

Topographic features of the Hudson Valley and the question of post-glacial marine waters in the Hudson-Champlain Valley: JAMES H. STOLLER.

Subterranean "chalk-streams" of northern France: EDWARD MOORE BURWASH. (Read by title.)

The relative efficiency of normative and modal classifications of igneous rocks: EDWARD B. MATHEWS.

Pegmatite, silexite and aplite dikes of northern New York: WILLIAM J. MILLER.

Magnetic iron ore deposits of Clinton County, New York: WILLIAM J. MILLER.

High grade clays of the United States: H. RIES.

Occurrence and origin of white clays at Saylorsburg, Monroe County, Pa.: F. B. PECK. (Read by title.)

Oil geology in relation to valuation: RALPH ARNOLD. (Read by title.)

Rock products and the war: G. F. LOUGHLIN.

Manganese ore as a war mineral: D. F. HEWETT.

World view of mineral wealth: JOSEPH B. UMPLEBY.

Internationalization of mineral resources: C. K. LEITH.

Commercial control of the mineral resources of the world: JOSIAH E. SPURR.

The economic limits to domestic independence in minerals: GEORGE O. SMITH.

Imperial Mineral Resources Bureau, London, England: WILLET G. MILLER. (Read by title.)

Some problems of international readjustment of mineral supplies as indicated in recent foreign literature: ELEANORA F. BLISS. (Introduced by C. K. Leith.)

War time development of the optical industry: F. E. WRIGHT.

Geologic and present climates: MARSDEN MANSON. (Introduced by E. O. Hovey.) (Read by title.)

Conditions of deposition of some Tertiary petroliferous sediments: AMADEUS W. GRABAU. (Read by title.)

Phosphate rock an economic army: R. W. STONE.

Prevailing stratigraphic relationships of the bedded phosphate deposits of Europe, North Africa and North America: AMADEUS W. GRABAU. (Read by title.)

Principles in the determination of boundaries: A. P. BRIGHAM.

Geographic descriptions of army cantonments and of United States boundary regions: M. R. CAMPBELL. (Read by title.)

The Signal Corps school of meteorology: OLIVER L. FASSIG. (Introduced by N. M. Fenneman.)

The American topographer in the rôle of artillery orientation officer: F. E. MATTHES.

A method of aerial topographic mapping: FRED H. MOFFIT.

Mexican petroleum and the war: E. W. SHAW. (Read by title.)

American mapping in France: GLENN S. SMITH.

Military mapping—a plane table: ALAN BATEMAN. (Read by title.)

The sand chrome deposits of Maryland: JOSEPH T. SINGEWALD, JR.

The Cartersville potash slates, their economic relation to chemical and industrial post-war development: T. POOLE MAYNARD. (Read by title.)

The anticlinal theory as applied to some quicksilver deposits: JOHAN A. UDDEN.

Crystalline graphite deposits of Alabama: WILLIAM F. PROUTY. (Read by title.)

Evidence as to the age of the semi-crystalline and crystalline rocks: WILLIAM F. PROUTY. (Read by title.)

Contributions to the origin of dolomite: W. A. TARR. (Read by title.)

The magnesite industry: R. W. STONE.

Although the number in attendance at the meeting of the society was not as great as at some of the eastern meetings there were about one hundred and twenty-five members and guests registered. The papers presented were interesting and valuable, and the days were crowded with events.

Luncheon was secured each day, together with the American Association for the Advancement of Science and other affiliated societies, in the Machinery Hall of the university.

Friday evening was occupied with the subscription smoker at which was held a round table discussion, presided over by Professor Bailey Willis, on "Cooperation in Geological Instruction" led by Professor Herbert E. Gregory and participated in by Professors George F. Kay, Charles P. Berkey, J. C. Merriam and William M. Davis.

The annual dinner of the society held jointly with the Paleontological Society and the Association of American Geographers was held, under the chairmanship of President Whitman Cross, at the Southern Hotel on the evening of Saturday. Ad-

dresses were made by Professor Merriam, Dr. Henry M. Ami and Professor William M. Davis. The evening was closed with the reading of the presidential address by Dr. Cross, entitled "Geology in the War and After," and followed by the address of the retiring vice-president of Section E of the American Association for the Advancement of Science, George H. Perkins, entitled "Physiography of Vermont."

The officers for the ensuing year, beginning at the close of the Baltimore meeting, are as follows:

President—J. C. Merriam.

Vice-presidents—R. A. Penrose, Jr., Herbert E. Gregory, Robert T. Jackson.

Secretary—Edmund Otis Hovey.

Treasurer—Edward B. Mathews.

Editor—Joseph Stanley-Brown.

Councilors, 1919–1921—William S. Bayley, Eugene W. Shaw.

Edmund Otis Hovey,
Secretary

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

The tenth annual meeting of the society was held in Gilman Hall, Johns Hopkins University, Baltimore, Md., December 23–28, 1918, in affiliation with the American Association for the Advancement of Science and the Botanical Society of America.

About fifty members were present. The program was devoted chiefly to project conferences and reports of the War Emergency Board, accounts of which will be distributed separately. Sixteen papers were presented at the regular sessions, abstracts of these appeared in the January number of *Phytopathology*. Twenty-nine new members were elected.

Joint sessions were held with Section G of the American Association for the Advancement of Science and also with the Botanical Society of America.

The followng officers were elected:

President—C. L. Shear, U. S. Department of Agriculture, Washington, D. C.

Vice-president—I. E. Melhus, Iowa State College, Ames, Iowa.

Secretary-treasurer—G. R. Lyman, U. S. Department of Agriculture, Washington, D. C.

Councilor for two years—Donald Reddick, Cornell University, Ithaca, New York.

Associate Editors for three years—Geo. L. Peltier, Agricultural Experiment Station, Auburn, Alabama; F. D. Heald, Agricultural Experiment Station, Pullman, Washington; J. E. Howitt, Ontario Agricultural College, Guelph, Ontario, Canada, and J. B. S. Norton, Maryland State College, College Park, Maryland.

Business Manager of Phytopathology—G. R. Lyman.

The society decided to hold its next annual meeting at St. Louis, Mo., in conjunction with the American Association for the Advancement of Science, December 29, 1919, to January 3, 1920.

Besides the papers presented at the War Emergency Board Conferences the following were read Saturday, December 28:

The Physoderma disease of corn: W. W. Tisdale.

Macrosporium solani on tomato fruit: Jos. Rosenbaum.

Notes on the rusts of the Piñon pines: Ellsworth Bethel, N. Rex Hunt.

Hot water seed treatment for blackleg of cabbage: J. B. S. Norton.

Fungi which decay weaveshed roofs (with lantern): R. J. Blair.

Resistance in the American chestnut to the Endothia canker (with lantern): A. H. Graves.

Investigations of white pine blister rust, 1918: Perley Spaulding.

Isolation of fungi from manufactured sugars: Nicholas Kopeloff.

On Wednesday evening, December 25, there was a dinner and a special program in celebration of the tenth anniversary of the organization of the society. The following papers were presented:

Our journal, "Phytopathology": L. R. Jones.

The first decade of the society: C. L. Shear.

The reading of these papers was followed by a general discussion of society problems and relations which proved interesting and valuable.

C. L. Shear,
Secretary-Treasurer

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

VALENCE[1]

The theory of valence is one of the most important theories of chemistry. Scarcely any other except the atomic theory, with which it is inseparably connected, has been so fruitful in results which have led to industrial applications and also to the development of chemical knowledge. In spite of these results, which no one can dispute, the theory is more or less in disrepute, especially among physical chemists and students and teachers of inorganic chemistry. In many of our elementary text-books structural formulas are used so sparingly that they make no impression on the student and in some of them they are not even mentioned.

This attitude is due, in part, to a reaction from the overemphasis given to the subject at a time when nearly all chemists were working on the structure of organic compounds. It is due, also, to confused and conflicting ideas about the philosophy of science.

Some have gone so far as to claim that speculations and hypotheses form no part of genuine science. To such persons science is only an orderly description of phenomena which we can see and handle, which we can weigh and measure and connect by mathematical processes. An attempt to acquire knowledge about atoms and electrons and molecules, so long as they remain beyond the direct cognizance of our senses, may be interesting but to followers of this school such attempts form no part of science.

To an organic chemist the achievements in the determination of the structure of carbon compounds demonstrate the falsity of such a claim. It may be remarked, in passing, that

[1] Address of the chairman and retiring vice-president of Section C—Chemistry, American Association for the Advancement of Science, Baltimore, December 27, 1918.

the philosophy of science referred to easily leads to the conclusion that the discovery of new facts is of supreme value in science and that one is doing good scientific work when he adds a few facts to our already unwieldy accumulation of knowledge, whether the facts discovered have any valuable relation to fundamental principles or not.

Another school of philosophers contends that the number of explanations which will fit any given set of natural phenomena is infinite, and that, for this reason, any explanation which we use, as for instance, the Copernican system or the atomic theory, is purely a product of our imagination and that it is hopeless ever to arrive at a system which shall actually correspond to the realities of the universe. This, if I understand him correctly, was the point of view held by Poincaré. It is only a step from this to the conclusion that there is no reality outside of our own minds, for, surely, if we can never attain to a knowledge of realities outside ourselves, for all practical purposes such realities do not exist.

A more true philosophy of science, as it seems to me, recognizes the intimate connection between speculation, hypothesis and theory on the one hand and the accurate study of phenomena on the other. Neither is complete or sufficient alone. Science advances most rapidly by what may be called a "cut-and-try" method. Speculation alone led to the useless dialectics of the school-men. A study of phenomena alone leads to an almost equally barren accumulation of facts for which we have no earthly use. It is inconceivable that chemistry, or indeed, that science as a whole could have made the progress that it has during the last century if Dalton, or some one else, had not given us the atomic hypothesis as a key for the study of chemical phenomena.

The subject of valence furnishes a particularly good illustration of the methods by which science advances. The positive achievements of the theory are so great that no one can doubt that there is some reality in the relations of atoms which corresponds to the theory. At the same time our knowledge is so vague and indefinite at many points that we must consider the theory as still very unsatisfactory and in need of further development.

Ernst von Meyer has pointed out with some truth that the theory of valence is implied in the Law of Multiple Proportions. A somewhat more definite approach was made when Graham demonstrated the polybasic character of phosphoric acid. His results were expressed, however, in the old dualistic formulas in which one, two or three molecules of water of hydration in the acid were considered as replaced by one, two or three molecules of a metallic oxide. When Liebig introduced the idea that acids are compounds of hydrogen the notion of polybasic acids became still more definite and the fact that an atom of antimony may replace three atoms of hydrogen while an atom of potassium replaces only one was given a clear statement. During the same period the discovery of the chloroacetics acids by Dumas and the development of the theory of types by Gerhardt and others gave greater precision to our knowledge of the replacement of one atom by another and it became evident that in such replacements one atom of oxygen may take the place of two atoms of chlorine.

Thus far the rudiments of the idea of valence had been developed only on the basis of the replacing power of different atoms. In 1852 Frankland went a step further and introduced the more exact conception of a definite, though variable, combining power for different atoms. Using the atomic weight 8 for oxygen he gives the formulas NO_3, NH_3, NI_3, NS_3; PO_3, PH_3, PCl_3; SbO_3, SbH_3, $SbCl_3$; AsO_3, AsH_3, and NO_5, NH_4O, NH_4I; PO_5, PH_4I, etc., to show that the elements nitrogen, phosphorus, arsenic and antimony combine with either three or five atoms of other elements. He also pointed out that when an atom of tin is combined with two ethyl groups in tin ethyl, $Sn(C_2H_5)_2$, it will take up only one atom of oxygen, giving the

compound, $Sn(C_2H_5)_2O$, while an atom of tin alone will combine with two atoms of oxygen to form stannic oxide, SnO_2.

A few years later Couper and Kekulé, quite independently of each other, developed clearly the idea that carbon compounds are held together in chains by attractions between the atoms and that the structure of the molecules of such compounds is directly dependent on the valence of the atoms of which they are composed.

In the same year, 1858, at Genoa, Cannizzaro revived the hypothesis of Avogadro and Ampère and gave such convincing evidence of its truth that it was soon accepted by the leading chemists of the world. This introduction of a correct system of atomic and molecular weights aided greatly in the very rapid development of structural organic chemistry. We can still imagine with what enthusiasm the chemists of that day seized the key to nature's mysteries which the doctrines of valence and of the linking of atoms had given them and applied them to the solution of problems of structure and of synthesis. Only a few years before the thought of definite, accurate knowledge of this kind would have seemed the dream of a hair-brained visionary.

Chemistry is primarily an experimental science. New theories make their way slowly and speculations which are not forced upon us by incontrovertible facts have met with little favor. At the time when the theory of valence made itself indispensable as a guide to the investigation of carbon compounds the older electrochemical theory had practically disappeared and no theory for the cause of the attraction between atoms received more than passing attention. It was tacitly assumed that some sort of attraction between atoms held them bound together but even such necessary terms as "single bonds" and "double bonds" or "linkages" were used with reserve by many chemists.

During the forty years following the publication of the papers by Couper and Kekulé the theory was amplified in only one important detail. The original theory considered only the sequence of atoms in compounds. While there may have been occasional thoughts about arrangements in space, chemists were very reticent in expressing them. In 1874, however, van't Hoff proposed an explanation of the relation between the structure of optically active compounds and the arrangement of their atoms, based on the fundamental proposition that four univalent atoms or groups combined with a given carbon atom are arranged symmetrically about the center of the atom. From the same starting point he postulated the supposition that two carbon atoms connected by a double union can not rotate independently about the points of union. The first hypothesis gave a satisfactory explanation for optically active compounds and it is impossible now for any one to question the fact that a compound which is optically active in solution must contain a central atom or group around which four or more atoms or groups are arranged in an asymmetric fashion. Incidentally it may be remarked that the discovery of compounds in which the asymmetric atom is nitrogen or sulfur or tin demonstrates that the principle of valence is general in its application and is not simply of value for carbon compounds.

The use of van't Hoff's principle in the explanation of the isomerism of such compounds as fumaric and maleic acids was equally successful.

In 1885 Bayer gave the following statement of the well-established principles used in explaining the structure of carbon compounds:

1. Carbon is usually quadrivalent.

2. The four valences are alike.

3. The valences are symmetrically directed in space from the center of the carbon atom.

4. Atoms attached to the four valences do not easily exchange places—van't Hoff's principle.

5. Carbon atoms may be united with one, two or three valences.

6. The compounds may be either open chains or rings.

Baeyer proposed a seventh principle:

7. The directions in which the valences are exerted may be diverted from the normal angle of the tetrahedron, which is 109° 28′,

but the tension which results renders the compound less stable.

He explained in this manner the extreme instability of acetylene compounds and the ease with which additions are made to double unions; also, the instability of rings of three carbon atoms in comparison with those of four or five atoms. This so-called "tension theory" has been very suggestive and useful.

An interesting confirmation of the ease with which rings containing six atoms are formed and evidence that rings containing seven atoms are not so natural was discovered, almost by accident, by Mr. Potter and myself a few years ago. Aminocamphonanic acid, usually written,

$$C_8H_{14}\left\langle\begin{matrix}CO_2H\\ NH_2\end{matrix}\right.,$$

is a compound in which the carboxyl and amino groups are separated by three carbon atoms. It is derived from *d*-camphoric acid,

$$C_8H_{14}\left\langle\begin{matrix}CO_2H\\ CO_2H\end{matrix}\right.,$$

and we should expect it to have a right handed rotation for polarized light. Both the free acid and its anhydride,

$$C_8H_{14}\left\langle\begin{matrix}CO\\ |\\ NH\end{matrix}\right.,$$

are, however, left-handed in rotation. The anhydride of its homologue, α-aminocampholic acid,

$$C_8H_{14}\left\langle\begin{matrix}CO\\ CH_2\end{matrix}\right\rangle NH,$$

is also a lævo compound.

The hydrochloride of aminocamphonanic acid,

$$C_8H_{14}\left\langle\begin{matrix}CO_2H\\ NH_3Cl\end{matrix}\right.,$$

has the right-handed rotation which would be expected of the free acid. If we add to a solution of the hydrochloride one mol of sodium hydroxide, liberating the free acid, the rotation of the solution changes, from right-handed to left-handed. The addition of a second mol of sodium hydroxide, forming the sodium salt,

$$C_8H_{14}\left\langle\begin{matrix}CO_2Na\\ NH_2\end{matrix}\right.,$$

again causes a right-handed rotation in the solution. Similar relations were found for a number of allied compounds. The only simple explanation which is apparent is that the free acid has the cyclic structure,

$$C_8H_{14}\left\langle\begin{matrix}CO\\ NH_3\end{matrix}\right\rangle O.$$

The homologue,

$$C_8H_{14}\left\langle\begin{matrix}CO_2H\\ CH_2NH_2\end{matrix}\right.,$$

on the other hand, is a dextro compound and both its hydrochloride and its sodium salt are right-handed, indicating that the free acid, which would require the formation of a ring of seven atoms to form a cyclic salt, does not form such a salt.

These relations seem to establish, also, the quadrivalence of nitrogen in ammonium salts. It seems impossible to reconcile this with Werner's idea that the fourth hydrogen of the ammonium group remains combined with the acid radical in such salts.

In 1899 Thiele proposed his theory of partial valences to account for the addition of bromine, hydrogen, or two other atoms or groups to the end carbon atoms in conjugated double unions, which have the structure $>C{=}CH{-}CH{=}C<$. The compound formed has the structure $>CX-CH{=}CH-CX<$. This relation always reminds me of two bar magnets in which the north pole of one is in contact with the south pole of the other $\boxed{N\ S\,|\,N\ S}$. At the center of such a system no attraction will be exerted but the free ends will exert their usual attraction. While this is an analogy rather than an explanation, and is also rather closely related to Thiele's idea, it seems to me better than that which he has expressed. If we attach any definite meaning of localized attraction to the term valence it is difficult to conceive of the valence as being divided, as seems to be implied in the term, "partial valence."

Werner in discussing this point, and also in discussing the Walden inversion and other topics, rejects the idea of localized attraction and prefers the notion of a general attraction of the atom as a whole. But a general attraction seems hard to reconcile with the fact that it is never satisfied by more or less than four univalent atoms or groups.

In 1887 Arrhenius proposed his theory of electrolytic dissociation, or, as it is better called, of ionization. The attention of chemists was once more directed to the intimate relation between electrical forces and chemical affinity. About ten years later J. J. Thomson demonstrated the existence of electrons as definite units of negative electricity having a mass eighteen hundred times smaller than that of the hydrogen atom. Almost at the same time the first discoveries of radioactive elements were made and as these were developed Rutherford brought out his theory of the disintegration of atoms. It soon became evident that atoms are not homogeneous, indivisible particles, as had been more or less tacitly supposed but that they must be complex aggregates of electrons and much more dense material with a positive charge. J. J. Thomson made an attempt to account for the properties of atoms by supposing a uniform positive sphere into which electrons found their way and distributed themselves in accordance with their attraction for the positive matter and their repulsion for each other. In contrast with this Bohr, Rutherford and others have assumed a very dense central nucleus, with a positive charge, about which electrons are in very rapid rotation. Experimental evidence based especially on the scattering of helium atoms which are shot through a thin film of gold or other metals has given very positive evidence in favor of atoms with a central nucleus. Some progress has been made in the discussion of the relation between the spectra of some of the elements and the revolving electrons of their atoms.

While physicists have been busy with studies of radioactivity and have reached some rather positive conclusions about atoms, which are certainly dynamic, rather than static, chemists have been busy with the applications of the new electro-chemistry in its relation to the electron theory. It is evident that in ionization a positive univalent ion has lost an electron and a negative ion has gained one. Chemists have usually been very reticent about the fate of these electrons when ions unite but it seems rather certain that some atoms still retain their position or negative character in their compounds. This was first definitely pointed out for nitrogen trichloride, in which the chlorine is positive, as contrasted with nitrosyl chloride, NOCl, in which it is clearly negative.

The evidence for the existence of positive chlorine in nitrogen trichloride and of negative chlorine in nitrosyl chloride is usually stated to be that the trichloride hydrolyzes to ammonia and hypochlorous acid while nitrosyl chloride hydrolyzes to nitrous acid and hydrochloric acid. Recent experiments, not yet published, have shown that dry ammonia and chlorine react with the formation of the trichloride and also that a dry solution of the trichloride reacts with dry hydrochloric acid to form ammonium chloride and chlorine. These facts seem to prove that the trichloride is formed by the addition of chlorine to ammonia, forming chloroammonium chloride, $NH_3Cl^+Cl^-$, followed by the splitting off of hydrochloric acid, and a repetition of the process till all of the hydrogen is gone. On the other hand, the decomposition of the trichloride by hydrochloric acid is caused by the addition of the acid, giving trichloroammonium chloride, $NCl_3H^+Cl^-$, followed by the splitting off of a positive and a negative atom of chlorine, as free chlorine. Under suitable conditions these reactions may be practically quantitative in either direction.

The close analogy between these reactions and those which take place in the substitution of chlorine for hydrogen in methane or in benzene is very striking and recalls Michael's theory that addition compounds are at first formed in such cases. The idea which is partly new is that such additions are always of two atoms or groups, one of which is

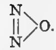
positive and the other negative. Also that atoms may form unstable compounds of higher valence when one of the new valences is positive and the other negative. The instability of such compounds is due to the fact that they contain two atoms or groups of opposite sign.

This is closely related to Abegg's contravalences, according to which the non-metallic elements, in particular, exhibit maximum positive and negative valences the sum of which is eight. Thus sulfur has a negative valence of two in hydrogen sulfide and a positive valence of six in sulfur trioxide and in sulfuric acid. But sulfur very readily assumes three negative valences, in such compounds as triethyl sulfonium iodide, $(C_2H_5)_3SI$, in which it has also assumed one positive valence. We may assume that methane, in a similar manner forms with chlorine the compound $CH_4Cl^+Cl^-$, which at once splits off hydrochloric acid.

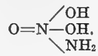
It seems worth while to remark that we have much need of revising our conception of the non-metallic elements as being *negative* elements. This is based on the fact that the halogens when univalent form their most stable compounds as negative atoms and also because nitrogen, sulfur and similar elements form very stable negative groups, such as SO_4, NO_3, etc. We are a little apt to forget that oxygen forms the negative part of these groups and that nitrogen and sulfur are *positive* in them. Some apparent anomalies in the laws for the orientation of substituting groups in benzene derivatives are easily explained when these facts are kept in mind.

It will have been noticed that very much importance is attached, above, to additions and decompositions in which the two groups or atoms added or split off are of opposite sign. Nef, Michael and others have often emphasized the importance of reactions of this type but at a time when an accurate consideration of the positive or negative character of the atoms or groups involved was not in vogue.

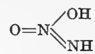
Some of our ideas need revision, as it seems to me, in this regard. Let us take the commonly accepted formula of nitrous oxide,



The compound is formed by the decomposition of ammonium nitrate. This would almost certainly begin by the splitting off of hydrogen and NO_3, giving ammonia and nitric acid. Besides recombining to ammonium nitrate part of the ammonia would add itself to the nitric acid, giving



Such a compound would lose water, giving



first and then O=N≡N. Such a structure takes account of the probability that one nitrogen atom remains positive and the other negative throughout the series while the formula usually given implies that at least one valence of one nitrogen atom changes from negative to positive. The formula here proposed also seems more in accord with the ease with which nitrous oxide gives up its oxygen.

I can not take the time to consider the very interesting discussions of Falk and Nelson, of Fry and of Jones nor the valuable additions to our experimental knowledge made by the last two. As was remarked at the beginning, every important advance must combine experimental evidence with new explanations of natural phenomena.

G. N. Lewis has proposed the hypothesis that carbon compounds are not held together by polar valences because they do not readily ionize. It seems possible that this is true in some cases but it is difficult to believe that there is any very essential difference between the reaction of methyl iodide with silver nitrate and that of potassium iodide with the same reagent.

Werner distinguishes between primary valences which hold simple compounds together and also cause the binding of carbon atoms, and secondary valences, which are effective in the formation of complex, molecular compounds. Strong reasons have been given for thinking that the ammonium compounds are

genuine valence compounds and not molecular compounds, as Werner supposes them to be. If we assume rotating electrons, as we are almost compelled to do, molecules may well be held together by magnetic attractions and it seems possible that such attractions give rise to the secondary valences of Werner. He and his students have done magnificent work in the study of complex inorganic compounds, and some apparent contradictions between his ideas and those of organic chemists will doubtless be cleared up in the future.

To repeat, the most important recent advance in the theory of valence has been the interpretation of the theory in connection with the electron theory and a beginning toward the study of positive and negative atoms in organic compounds.

It is not very safe to prophesy, but I am impressed with the need of a more definite knowledge of the structure of atoms as a basis for a better understanding of valence. So much progress has been made in this direction during the past twenty years that further advance seems probable. Several different lines of study may be suggested, the coördination of which might lead to further knowledge.

The spectra of the elements must be intimately connected with the structure of the atoms. Professor Morley once suggested that the problem is something like that of a man who should endeavor to determine the mechanism of a grand piano with only sound waves to guide him. Yet the matter seems by no means hopeless and a beginning has already been made. It is noticeable that spectral lines are only given out by ionized gases and are possibly connected with the motion of valence electrons.

Certain forms of structure, especially those forms in which there are what Baeyer so aptly called *fliesende doppelte Bindunge,* absorb light of certain wave-lengths and give us colored compounds. This means that it is possible to calculate exactly the rate at which certain atoms, or parts of atoms, or of molecules vibrate.

The atomic numbers determined by X-ray spectra must be due to some more rapid and very fundamental sort of vibration which changes as the nucleus of the atom increases in weight from one element to another of the periodic system.

By means of X-rays it has been possible to determine the actual arrangement of atoms in crystals. The conclusion has been drawn from some of this work that the results do not agree with our customary conceptions of valence. I am inclined to think that the achievements of organic chemistry are not to be discarded so easily.

The Walden inversion has been interpreted by Fischer and Werner in terms of general attraction between atoms as opposed to localized attraction. The subject deserves careful study.

The evidence from radioactive disintegrations that helium atoms and electrons form essential parts of some atoms and very probably of all, is certainly important. The speculations of W. D. Harkins in this connection may be mentioned. The enormous quantity of energy liberated by the disintegration of an atom is certainly significant.

Three suggestions as to the functions of electrons in holding atoms together may be mentioned. One is that one or two electrons rotate about a line joining the centers of two positive nuclei, at a point midway between them. In ionization these electrons must remain with the negative ion. A second suggestion is that the magnetic effect produced by rotating electrons may cause an attraction between atoms. This is the magneton theory of Parsons and something of the same sort was suggested by Sir William Ramsay in the last paper which he published. It would also account for the non-polar combinations of G. N. Lewis. A third suggestion is that an electron may rotate about positive nuclei situated in two atoms. The velocity of electrons must be so much greater than ordinary motions of atoms that the atoms might be kept together in this way.

Whatever conclusions may finally be reached with regard to the structure of atoms it seems very certain that the structure will be found

to be dynamic rather than static. It is hard to conceive of a quiescent electron.

William Albert Noyes

SOME RECENT CONTRIBUTIONS TO THE PHYSICS OF THE AIR. II

BAROMETRIC FLUCTUATIONS

Another meteorological phenomenon that has been the subject of numerous investigations, is the pressure of the atmosphere. This pressure undergoes many changes, and the causes of some of them, such as its variations between summer and winter, and between ocean and continent, have long been known. But the causes of certain others, notably the great changes that accompany cyclones and anticyclones, have not yet been fully determined. Neither of these classes of changes, that is, those whose causes have long been known, and those whose causes still remain partially obscure, will be discussed here, though each is important and full of interest. But there are two other classes, namely, barometric ripples, and the pressure wave of semi-diurnal period, that, because of their obvious interest to physicists, will be briefly considered.

Barometric "Ripples."—Small pressure changes having amplitudes usually of 0.1 mm. to 0.3 mm. and periods of 5 minutes to 10 minutes, and continuing for hours or even days together, are very common during cold weather. They are not greatly different in magnitude from the well known wind effects on the barometer, but obviously of different origin since their amplitude has no relation to the local wind velocity.

Their explanation appears to lie in the fact that whenever layers of air that differ in density at their interface flow over each other, long billows, analogous to water waves, and generated in the same way, are produced. If, now, the under layer is colder than the upper, as it is during the radiation or surface inversions of winter, and rather shallow, 100

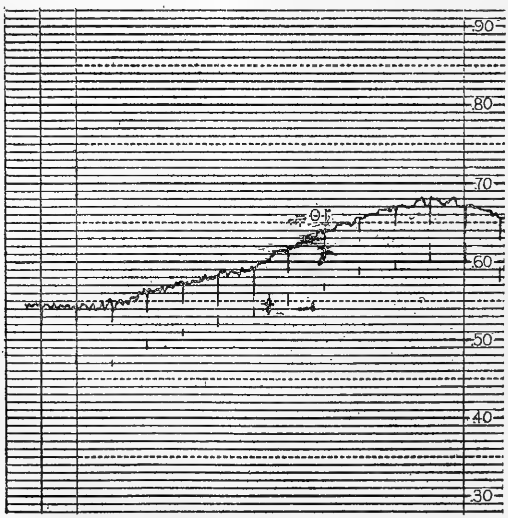


Fig. 4. Barometric Ripples.

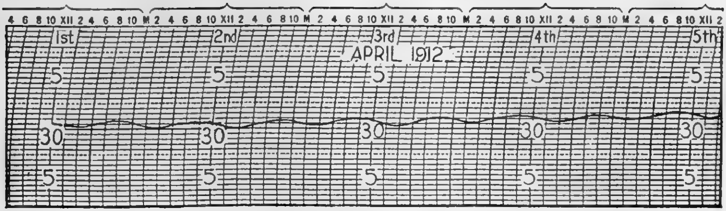


FIG. 5. Balogram, Grand Turk Island, West Indies.

meters to perhaps 500 meters thick, the passage of the air billows, like the passage of waves in shallow water, necessarily produces greater or less corresponding changes in the pressure on the bottom—changes that, as shown in Fig. 4, appear as a series of ripples in the record of a sensitive barograph.

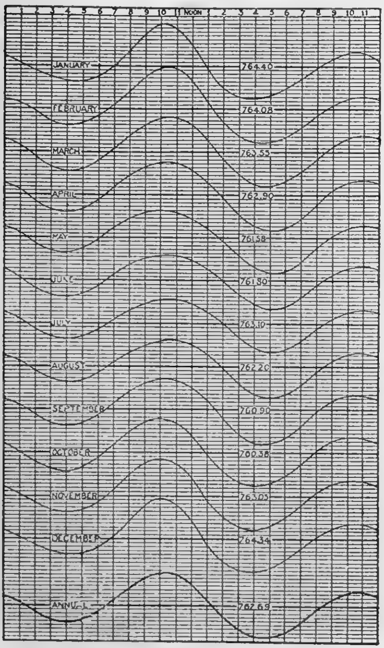


FIG. 6. Average daily barometric curves, Key West, Florida.

During the summer, when air billows rarely form near the surface, though frequently at greater altitudes, especially that of the cirrus cloud, barometric ripples do not appear. This, doubtless, is because wave disturbances in air, as in water, do not penetrate far beneath the wave level.

Semidiurnal Pressure Changes.—It has been known now for more than two and a half centuries that there are approximately regular daily variations in the height of the barometer that culminate in two maxima and two minima in the course of twenty-four hours. During particularly calm weather these fluctuations are conspicuous on the current barogram, as shown in Fig. 5, obtained at Grand Turk Island, West Indies, and always revealed by averages, no matter how masked by storm conditions, as shown by Fig. 6, based on records, covering fourteen years, at Key West, Fla.

Although, as stated, this phenomenon of the semidiurnal variation of the atmospheric pressure has been familiar almost since the invention of the mercurial barometer, and although repeatedly studied, its cause or causes remained until quite recently wholly unknown.

Some of the observed facts in regard to this twelve-hour cyclic change of pressure are:

(*a*) The maxima occur at, roughly, 10 o'clock A.M. and 10 o'clock P.M.

(*b*) The minima occur at, roughly, 4 o'clock A.M. and 4 o'clock P.M.

(*c*) The amplitude, when other things are substantially equal, varies with place approximately as the square of the cosine of the latitude.

(*d*) The amplitude is everywhere greatest on equinoxes and everywhere least on solstices.

(*e*) The amplitude is greater at perihelion than at aphelion.

(*f*) The amplitude is greater by day than by night.

(*g*) The amplitude is greatest on clear days and least on cloudy days.

(*h*) The day amplitude is greater over land than over water.

(*i*) The night amplitude is greater over oceans than over continents.

(*j*) Over the tropical Pacific Ocean the forenoon maximum is about 1 mm. above, and the afternoon minimum 1 mm. below the general average pressure.

Taken together these facts compel the conclusion that the daily cyclic pressure changes are somehow the results of temperature changes. Many efforts have been made to find just how the two are connected—how, for instance, a diurnal change in temperature can produce a semidiurnal change in pressure, but until recently without much success. To be sure, the diurnal temperature curve is not a simple sine curve of twenty-four hours period, and, like any other curve, can be closely duplicated by a series of superimposed sine curves of proper amplitudes and periods. But this is far from satisfying to the average physicist, and particularly so if he has not yet seen by what process the actual unanalyzed temperature changes can produce corresponding pressure variations in the open atmosphere. Of course it may be argued that there must always be a flow of air from the warmer to the colder regions, and, therefore, a pressure wave of diurnal period perpetually sweeping around the earth. Such a wave does indeed appear in the analyzed data. And as the temperature curve yields sine waves of twenty-four hours, twelve hours, eight hours and other periods, so, therefore, may the pressure curve also. But while this may be a portion of the story, it certainly is not the whole of it. There are other and important connections between temperature changes and pressure variations that must be considered; and these indeed seem to be the chief factors in producing the semidiurnal pressure wave.

One of these factors is vertical convection, first suggested, but never adequately developed, by Cleveland Abbe. Indeed, it appears to be the principal cause of the forenoon maximum as the following consideration shows:

Let the mass m of air be near the ground and have the horizontal velocity v, and let the larger mass M be at a higher elevation and have the greater velocity V in the same direction. If now these two masses should mingle in such manner as to be free from all disturbance, except their own mutual interference, the resulting final velocity, U, in the same direction, would be given by the equation

$$U=\frac{mv+MV}{m+M}$$

and there obviously would be no check in the total flow—no damming up and consequent increase of pressure. But this simple mixing of the two masses is by no means all that happens in the case of vertical convection. The rise of the mass m is simultaneously accompanied by an equivalent descent of air from a higher level, which in turn loses velocity, directly or indirectly, by surface friction. If the falling mass is also m, and if its velocity is reduced by friction to v, then from a single interchange, due to vertical convection, the total momentum becomes

$$2\,mv+(M-m)V$$

and the total flow is reduced by the amount

$$m(V-v).$$

But as this is for a single interchange, it is obvious that the more active vertical convection becomes, the greater will be its interference with the flow of the atmosphere, the more the winds will be dammed up, and the higher the barometric pressure. As convection increases, reaches a maximum, and then decreases, so, too, will the resulting interference go through the same changes.

Now the general movement of the atmosphere is from east to west within the tropics and from west to east at higher latitudes. Therefore in either case such damming up

of the air as vertical convection may produce will be essentially along meridians, and thus a function of the time of day. But, in general, convection increases most rapidly during the forenoon, say eight to nine o'clock, is most active at ten to eleven o'clock, and reaches its greatest elevation about four o'clock in the afternoon. Hence the damming up of the atmosphere, due to vertical convection, and the resulting increase of barometric pressure must increase most rapidly during the forenoon, and come to a maximum about ten o'clock. After this the convectional interference decreases, while at the same time the amount of air in a vertical column of fixed cross-section diminishes as a result of expansion and overflow, until at about four o'clock in the afternoon the barometric pressure has, as a result of this overflow, reached a minimum.

To form some idea of the magnitude of the barometric change due to convectional turbulence, consider the atmosphere between two parallels of latitude near the equator. This limited quantity may be regarded as a stream flowing around the earth, having its minimum velocity and maximum depth where convectional interference is greatest, and maximum velocity with minimum depth where convection is absent. And since the linear velocity of a point on the equator is approximately 28 kilometers per minute, while during the forenoon the rate of increase of the barometric pressure at the same place is, roughly, 0.2 mm. per hour, it follows that a damming up, or check in the flow, of the given stream at the rate of 0.44 kilometers per hour would be sufficient of itself to account for the observed rise in the barometer. But if the average velocity of the wind, or flow of the stream in question, is 10 meters per second, which it may well be, the rate of decrease in velocity requisite for the given rate of pressure increase could be produced by having only 1 part in 80 of the whole superincumbent atmosphere brought to rest per hour, or the equivalent thereof, an amount that perhaps is reasonable. At any rate, the assumed velocity decrease is of the same order of magnitude as that observed to take place during, and as the result of, diurnal convection.

It appears then:

(*a*) That the afternoon minimum is caused essentially by overflow from the region where the atmosphere is warmest, or better, perhaps, from the meridian along which the temperature increase has been greatest, toward that meridian along which there has been the greatest decrease in temperature.

(*b*) That vertical convection interferes with the free horizontal flow of the atmosphere and to that extent dams it up and correspondingly increases the barometric pressure; also, that the time of this interference agrees with the forenoon changes of the barometer, and that its magnitude is of about the proper order to account for the forenoon barometric maximum.

The afternoon barometric minimum and the forenoon maximum, therefore, are to be regarded as effects of temperature increase; the minimum as due to expansion and consequent overflow; the maximum as caused by vertical convection and consequent interference with the free circulation of the atmosphere.

The forced afternoon minimum would occur in an otherwise stagnant atmosphere, and substantially as at present; but not so with the forced forenoon maximum, since the interference or damming effect depends upon a flow or circulation of the atmosphere, parallel roughly to the equator.

It remains now to account for the night ten o'clock maximum and four o'clock minimum, both of which appear to depend upon the natural or free vibration of the atmosphere as a whole.

This subject has been discussed by several mathematical physicists of great eminence. The latest and most complete of these discussions is by Lamb, who concludes:

> Without pressing too far conclusions based on the hypothesis of an atmosphere uniform over the earth, and approximately in convective equilibrium, we may, I think, at least assert the existence of a free oscillation of the earth's atmosphere, of "semidiurnal" type, with a period not very dif-

ferent from, but probably somewhat less than, twelve mean solar hours.

Hence any cause of pressure change, having a semidiurnal period or approximately so, would, if of sufficient magnitude and proper phase, account for the twelve-hour barometric curve. All that is needed, apparently, to give the semidiurnal pressure curve is a pressure impulse of the same period, twelve hours, as that of the free vibration of the atmosphere as a whole. And this is furnished by the forced forenoon barometric maximum, followed six hours later at the same place by the forced afternoon barometric minimum. In other words, taken together, the forenoon and afternoon forced disturbances appear to occur with the proper time-interval necessary to set up and maintain the twelve-hour free vibrations of the atmosphere.

The course of events at each locality appears to be substantially as follows:

1. A forced forenoon compression of the atmosphere, followed by its equally forced afternoon expansion, the two together forming one complete barometric wave, with a ten o'clock maximum and a four o'clock minimum, in harmony with the free vibration of the entire atmospheric shell.

2. Non-disturbance through the night or during the time of a single free vibration.

3. Repetition the following day of the forced disturbance in synchronism with, and therefore at such time as to reenforce, the free vibrations.

The series of disturbances is continuous, forced by day and free by night, but the resulting amplitudes of the barometric changes are limited, through friction and through the absence of perfect synchronism, to comparatively small values. Each point upon the atmospheric shell receives at every alternate swing a forced impulse in phase with the free vibration, and therefore at such time and in such manner as indefinitely to maintain the vibrations of the atmosphere as a whole.

The forenoon maximum and the afternoon minimum are primary disturbances equally forced but in different ways by the daily increase of temperature, while the evening maximum and the morning minimum are secondary disturbances caused by the joint action of the forced primaries through the twelve-hour free vibration of the atmosphere. In short, the semidiurnal swing of the barometer is a result of merely fortuitous circumstances—of the fact that the mass of the atmosphere happens to be such that the period of its free vibration is approximately just one half that of the earth's rotation.

ATMOSPHERIC ELECTRICAL PHENOMENA

The selected contributions to the physics of the air just reviewed belong to the domains of mechanics and thermodynamics. But there have also been recent contributions to other branches of the subject, especially to atmospheric electricity, among them,

(*a*) The discovery in 1900 by C. T. R. Wilson and, also, by H. Geitel of spontaneous ionization in the atmosphere.

(*b*) The discovery in 1902 independently by Rutherford and Cook, and by McLennon and Burton, of a penetrating radiation in the lower atmosphere, presumably from radioactive substances near the surface of the earth.

(*c*) The discovery in 1905 by Langevin of slow moving or large ions in the atmosphere.

(*d*) The discovery by Simpson in 1908 and 1909 that the electric charge on thunderstorm rain, and precipitation generally, is prevailingly positive.

(*e*) The discovery in 1908, also by Simpson, of the probable origin of the electric charge of the thunderstorm.

(*f*) The discovery by Kolhörster in 1914 of an extremely hard or penetrating radiation in the atmosphere that seems to be of extra terrestrial origin.

Each of these several discoveries has its own peculiar interest, but the origin of the electric charge of the thunderstorm involves more meteorological phenomena than does any of the others, and, therefore, it is selected for further remarks.

Many have supposed that, whatever the genesis of the thunderstorm, the lightning, at least, is a product or manifestation of the free electricity always present in the atmos-

phere—normal atmospheric electricity. Observations, however, seem definitely to exclude this assumption. Thus, while the difference in electrical potential between the surface of the earth and a point at constant elevation is, roughly, the same at all parts of the world, the number and intensity of thunderstorms vary greatly from place to place. Further, while the potential gradient at any given place is greatest in winter, the number of thunderstorms is most frequent in summer, and while the gradient in the lower layer of the atmosphere, at many places, usually is greatest from 8 to 10 o'clock, both morning and evening, and least at 2 to 3 o'clock P.M. and 3 to 4 o'clock A.M., no closely analogous relations hold for the thunderstorm.

But how, then, is the great amount of electricity incident to a thunderstorm generated? Fortunately an answer to this question based on careful experiments and numerous observations, and that greatly aids our understanding of the interrelations between the various thunderstorm phenomena, has been given by Dr. G. C. Simpson, of the Indian Meteorological Department.

The chief conclusions drawn by Simpson from his observational data, and supported by numerous subsequent observations by other persons at widely separated places, are:

(*a*) That the charge on thunderstorm rain, amounting often to 5 to 10 electrostatic units per cubic centimeter, usually is positive.

(*b*) That, on the whole, the quantity of positive electricity brought down is more than three times greater than the negative.

While these observations were being secured a number of well-devised experiments were made to determine the electrical effects of each obvious process that takes place in the thunderstorm.

Freezing and thawing, air friction, and other things were tried, but none produced any electrification. Finally, on allowing drops of distilled water to fall through a vertical blast of air of sufficient strength to produce some spray, positive and important results were found, showing: (1) That breaking of drops of water is accompanied by the production of both positive and negative ions. (2) That three times as many negative ions as positive ions are released.

Now, a strong upward current of air is one of the most conspicuous features of the thunderstorm. It is always evident in the turbulent cauliflower heads of the cumulus cloud—the parent, presumably, of all thunderstorms. Besides, its inference is compelled by the occurence of hail, a frequent thunderstorm phenomenon, whose formation requires the carrying of raindrops and the growing hailstones repeatedly to cold and therefore high, altitudes. And from the existence of hail it is further inferred that an updraft of at least 8 meters per second must often occur within the body of the storm, since, as experiment shows, air of normal density must have approximately this upward velocity to support the larger drops, those of 4 mm. or more in diameter, and, because of its greater weight, even a stronger updraft to support the average hailstone.

Experiment also shows that raindrops of whatever size can not fall through air of normal density whose upward velocity is greater than about 8 meters per second, nor themselves fall with greater velocity through still air; that drops large enough, 4.5 mm. in diameter and up, if kept intact, to attain through the action of gravity a greater velocity than 8 meters per second with reference to the air, whether still or in motion, are so blown to pieces that the increased ratio of supporting area to total mass causes the resulting spray to be carried aloft or, at least, left behind, together with, of course, all original smaller drops. Clearly, then, the updrafts within a cumulus cloud frequently must be strong and therefore break up at about the same level, that of maximum rain accumulation, innumerable drops which, through coalescence, have grown beyond the critical size; and thereby, according to Simpson's experiments produce electrical separation within the cloud itself. Obviously, under the turmoil of a thunderstorm, such drops may be forced

through the cycle of union (facilitated by any charges they may carry) and division, of coalescence and disruption, from one to many times, with the formation on each at every disruption again *according to experiment*, of a correspondingly increased electrical charge. The turmoil compels mechanical contact between the drops, whereupon the disruptive equalization of their electrical potentials breaks down their surface tensions and insures coalescence. Hence, once started, the electricity of a thunderstorm rapidly grows to a considerable maximum.

After a time the larger drops reach, here and there, places below which the updraft is small—the air can not be rushing up everywhere—and then fall as positively charged rain, because of the processes just explained. The negative electrons, in the meantime, are carried up into the higher portions of the cumulus, where they unite with the cloud particles and thereby facilitate their coalescence into negatively charged drops. Hence the heavy rain of a thunderstorm should be positively charged, as it almost always is, and the gentler portions negatively charged, which also very frequently is the case.

Such in brief is Dr. Simpson's theory of the origin of the electricity in thunderstorms, a theory that fully accounts for the facts of observation and in turn is itself abundantly supported by laboratory tests and imitative experiments.

. . . .

The foregoing are only a selected few of the many recent contributions to the physics of the air, but they are sufficient, it is hoped, to show that meteorology is indeed a progressive branch of physics, and one eminently suitable to every type of scientific talent. The close observer, the clever experimentalist, and the keen analyst all can find in the phenomena of the atmosphere inexhaustible material and endless opportunities. But in science opportunity is only a synonym for duty, and of all words duty is the noblest.

W. J. Humphreys

U. S. Weather Bureau

SCIENTIFIC EVENTS

THE HISTORY OF MEDIEVAL INSTITUTIONS

Professor David Eugene Smith, of Teachers College, Columbia University, writes:

The Société de Scolastique Médiévale, founded by M. Francois Picavet, professor in and secretary of the Collège de France, was changed into the Société d'Histoire Générale et Comparée des Philosophies Médiévales in 1906. This society is interested in the study of the history of dogma and religion, the history of law, the history of letters, the history of philosophy, and the history of science. Monographs have been issued in all these several lines and others are in the course of preparation.

It may seem that this is not an opportune moment for scholars to be considering such a line of work. Upon this point a letter from M. Picavet, written just before the armistice, has this to say: "En ce moment ou nous ne pouvons, en raison de notre âge, que faire des voeux, pour les combattants ou venir en aide aux prisonniers, aux soldats et aux évacués des pays envahis, j'ai pensé que nous pourrions nous rendre utiles en préparant les moyens de nous suffire sur le terrain scientifique et universitaire, entre nous gens de l'entente et amis de l'entente."

Few scholars have been called upon to make a greater sacrifice in this war than M. Picavet, and his determination to continue his great work in the field in which he has done so much will doubtless appeal to all scholars in this country as in Europe.

M. Picavet would be glad to hear from American scholars who are interested in the work of the society and to have their names enrolled as sympathetic with its work. If they should later become so interested as to contribute in any way to the support of the society, this would be a welcome decision; but this is not the immediate purpose. It would be a helpful act if those interested in this line of work were to write to M. François Picavet, Collège de France, Paris, expressing their interest in the society.

If America could in some way secure an endowment of $24,000 for maintaining for ten years the chair which M. Picavet fills with such distinction in the Collège de France, a great impetus would thereby be given to this work.

ACTIVITY OF KILAUEA VOLCANO

Professor Vaughan MacCaughey, of the College of Hawaii, Honolulu, writes under date of January 22:

Within the past few days word has been received from Mr. L. W. De Vis-Norton, at Kilauea Volcano, of the remarkable activity of this famous crater. He states that "tremendous changes are in progress at Kilauea, and there is no indication whatsoever of any cessation of the monumental rising of the entire vast lava column. . . . Over the southwest brink, a wide stream of glistening lava is sluggishly flowing in the direction of the Ka'u Desert, not with the spectacular cascading torrents of the southeastern flows of last March, but with a steady, stealthy gliding, which gains ground slowly at its face, but which piles up into tremendous masses from its source forward. Upon this southwestern side there is no longer any indication of the Hale-mau-mau Pit."

A vivid description is given of the lava plateau which has been heaped up over the former pit; "it is in reality a vast tilted roof which has been built entirely over Hale-mau-mau; broken in four or five places by almost circular spatter-walls erected thereon, within whose circumference are lakes, fountaining heavily and flinging molten torrents outward over the walls to flow onward over the surface of the roof."

The effect is a peculiar one, for as the lava seeks the hollows and fills up irregularities, it is producing an almost perfectly smooth sweep of floor over a mile in circumference. This condition will be stable for several hours, and then, as though the superincumbent weight had become insupportable, vast sections of the plateau will sink inward, releasing from beneath gigantic torrents of crimson and orange liquid lava, which surge upward and roar away over the adjacent surfaces, causing them in their turn to collapse and provide more pyrotechnics upon a tremendous scale, and repeating the process over and over again.

"Were it not for the fact that the southwestern overflow is following *a most unusual process* of damming itself back in walls of its own building as it advances," states Mr. Norton, "we should be witnessing such a torrential discharge of lava as *has never been seen* at Kilauea within the memory of man."

It is becoming increasingly evident that the present Hale-mau-mau rise is the usual equinoctial rise upon a greatly magnified scale, due partly to the abnormal squeezing of the Hawaiian fissure system, and to the unusual smallness of the previous fall after the last solstice, when the lava column withdrew little more than a hundred feet.

Starting its upward movement from a mean level some two hundred feet *above* the normal, it is only natural that the column should have reached the pit-rim a full month earlier than was anticipated. Since the column will, in the ordinary course of events, continue to rise until the time of the equinox in March next, the overflow may be expected to then attain an unprecedented magnitude.

A PROPOSED AMERICAN SOCIETY OF MAMMALOGISTS

A committee of representative American mammalogists, including men from different parts of the country in its membership, has recently been at work on plans to organize a society for the promotion of interest in the study of mammalogy. It is intended that the society shall devote itself to the subject in a broad way, including investigations of habits, life histories, evolution and ecology. The plans call for the publication of a journal in which both popular and technical matter will be presented, for holding meetings both general and sectional, aiding research, and engaging in such other activities as may be deemed expedient. It is hoped to secure the active participation of all interested. The organization meeting will be held at the New National Museum, Washington, D. C., April 3 and 4, 1919, sessions commencing at 10:00 A.M. and 2:00 P.M. No program of papers has been planned for this meeting. The organization committee includes the following: Hartley H. T. Jackson, Chairman, U. S. Biological Survey; Walter P. Taylor, Secretary, U. S. Biological Survey; Glover M. Allen, Boston Society of Natural History; J. A. Allen, American Museum of Natural History; Joseph Grinnell, University of California; N. Hollister, National Zoological Park; Arthur H. Howell, U. S. Biological Survey; Wilfred H. Osgood, Field Museum of Natural History; Edward A. Preble, U. S. Biological Survey; Witmer Stone, Academy of Natural Sciences of Philadelphia. Further information will be furnished by either the chairman or the secretary, to whom applications for charter membership should be transmitted.

SCIENTIFIC NOTES AND NEWS

The American Institute of Mining Engineers at its meeting in New York on Febru-

ary 18 elected as president Horace V. Winchell, of Minneapolis, Minnesota. Other officers elected were as follows: *Vice-presidents:* Edwin Ludlow, Lansford, Pa.; A. R. Ledoux, New York, N. Y. *Directors:* J. V. W. Reynders, New York, N. Y.; George D. Barron, Rye, N. Y.; Charles F. Rand, New York, N. Y.; Louis S. Crates, Ray, Arizona; Stanley A. Easton, Kellogg, Idaho. A memorial meeting was held during the afternoon for members who fell in service. The number of those who served in the Army or Navy reached some eight hundred, and information had been received of the death of twenty-five of these.

Dr. J. F. Abbott, professor of zoology in the University of Missouri, has been appointed commercial attaché to the American Embassy at Tokyo.

Professor E. C. Franklin returned to Stanford University, California, in December, after spending the greater part of the past year in research on the synthetic process for the fixation of nitrogen.

Dr. Chas. H. Herty, editor of the *Journal of Industrial Chemistry,* has been appointed chairman of a committee of the American Chemical Society on an Institute for Drug Research.

At their last meeting, held February 3, the trustees of The American Museum of Natural History elected Mr. Herbert L. Bridgman of New York an honorary fellow, in recognition of his valuable assistance rendered by service on a number of its most important exploration committees, and in special acknowledgment of his contribution to the advancement of science and education through his writings in the public press.

Dr. Louis Blaringhem, professor of agricultural biology at the Sorbonne, has been appointed exchange professor at Harvard University for 1918–19. Professor Blaringhem's term of service will fall in the second half-year.

The Janssen Prize of the Astronomical Society of France has been awarded to M. G. Raymond.

Sir Aubrey Strahan, director of the English Geological Survey, has been elected an honorary member of the British Institution of Petroleum Technologists.

Dr. G. Grandidier has been elected secretary of the French Geographical Society to fill the vacancy caused by the death of Baron Hulot.

Mr. J. C. Hostetter, of the geophysical laboratory, Carnegie Institution, has returned to Washington after a year's absence in charge of optical glass manufacture at Pittsburgh.

Dr. L. O. Grondahl, after having been commissioned a captain in the Ordnance Corps of the Army and having spent the last eighteen months in work on one of the problems of the Naval Consulting Board, has returned to his position as associate professor of physics, Carnegie Institute of Technology.

After twenty-one years of service in the Detroit high school and the junior college, Mr. Louis Murbach has resigned his position as head of the department of biology. His permanent address will be Castleton, Vt. He is succeeded by Mr. Norman Stoll, M.S., who besides high school experience has lately been teaching assistant in the department of zoology in the University of Michigan.

Major Edwin A. Ziegler, who had charge of the courses in orientation at the Coast Artillery School, Fort Monroe, Virginia, has resumed his work as director of the Pennsylvania State School of Forestry at Mount Alto.

Professor J. S. Illick, of the Pennsylvania State School of Forestry, has been appointed chief of the Bureau of Sylviculture in the Pennsylvania Department of Forestry.

Lewis A. Zimm has accepted an appointment as extension forester for Georgia and is connected with the Georgia State College of Agriculture. Mr. Zimm has been instructor in forestry and plant pathology at Cornell University and spent a season in dendropathological field work under Dr. Meinicke on the Pacific coast prior to his being commissioned in the army.

Dr. H. N. Holmes, head of the department of chemistry at Oberlin College, has finished a special piece of investigation connected with

the perfecting of gas masks. He has been appointed by the National Research Council member of a committee of four, known as the sub-committee on colloids.

Professor H. Burger, of Amsterdam, has been elected corresponding member of the laryngological section of the Royal Society of Medicine at London.

Mr. W. Boyd Campbell, assistant superintendent at the forest products laboratory, McGill University, Montreal, is now in charge of the chemical engineering work of the Process Engineers Limited Montreal.

The fourth lecture of Harvey Society will be given by Dr. Frederic S. Lee on "Industrial Fatigue" at the New York Academy of Medicine on Saturday evening, March 1.

Professor Robert F. Griggs, director of the National Geographical Society Katmai Expeditions, delivered an address on "Katmai and ten Thousand Smokes" before the Washington Academy of Sciences on February 18.

Dr. Aleš Hrdlicka, curator of the division of physical anthropology, United States National Museum, will give four lectures on "The Origin and Antiquity of the American Indian" at the Wagner Free Institute of Science. The lectures, which are in the Richard B. Westbrook foundation, will be given on March 8, 15, 22 and 29.

Sir R. H. Inglis Palgrave, distinguished for his work on economics and statistics died on January 25 at the age of ninety-one years.

Dr. Louis-Edouard Bureau, formerly profesor of botany at the Paris Museum of Natural History has died at the age of eighty-eight years.

Dr. Eugene Penard, of Geneva, Switzerland, has nearly completed his great work on the Infusaria, on which he has been working for five years. He has material for two volumes of 850 pages each, but it will be necessary, on account of the cost of the publication, to condense it to a single volume of 650 pages. Dr. Penard is much occupied at the present time with his duties as a member of the commission to administer relief to refugee Russians in Switzerland, under the American Red Cross.

UNIVERSITY AND EDUCATIONAL NEWS

A group of alumni, headed by George P. Adamson, have completed the endowment of the Edward Hart fellowship at Lafayette College. The endowment is in the sum of $10,000, yielding $500 per annum, and is open to students of chemistry holding the bachelor's degree desiring to do research work in problems connected with viscous and plastic flow. The endowment was made in honor of Professor Edward Hart, who has completed forty years as professor of chemistry at Lafayette.

The Women's College in Brown University received a gift of $50,000 to be used for a new dormitory.

Dr. Benjamin Ide Wheeler has presented his resignation as president of the University of California.

Professor D. W. Working, of the Office of Farm Management of the U. S. Department of Agriculture, has accepted the positions of dean of the Arizona College of Agriculture and director of the Agricultural Experiment Station.

In the absence on leave in Europe of Director H. Hayward, Professor A. E. Grantham, agronomist, has been appointed acting director of the Delaware College Agricultural Experiment Station beginning February 1. E. A. Hodson, of Cornell University, has been appointed assistant professor of agronomy.

Dr. W. E. Milne has been appointed professor of mathematics at the University of Oregon, to succeed Dr. R. M. Winger.

DISCUSSION AND CORRESPONDENCE

A STANDARD SCIENTIFIC ALPHABET

Standardizing is one of the unending labors of science. By accurate standards scientists are able to test and prove, to plan intelligently, and to indicate precisely. Scientists substituted a simple and definite metric system for a great number of irregular and unrelated

systems of measurement of dimension, capacity, weight, etc. They substituted the exact centigrade thermometer with 100 degrees between freezing and boiling of water, for the system without absolute bases. They gave America and other countries an exact decimal system of moneys. They devised a decimal system for classification, for books, correspondence, etc.

But in the field of sound-notation or sound-representation, nothing comparable with the foregoing contributions to the world's progress and civilization has been done. For untold ages, the general capacity of the human vocal organs to make sounds has been the same. Each has the same provision of lips, teeth, tongue, palate, and the same provision as to lungs, larynx, windpipe, pharynx and nasal passages. Every normal person can, if trained, at least when young, make exactly the same vocal sounds as can any other normal person.

Ages ago men began to use these vocal sounds to express ideas; spoken languages resulted. Ages later "Cadmus, the Phenicians, or whoever it was," Egyptians, or others, struck upon the thought that a certain mark might stand for a certain sound. An alphabet was devised. Others developed, either offshoots of the first, or independently. To-day we have many alphabets. They were made originally for a particular language or dialect, and were limited to the sounds of that tongue; or they were borrowed from another people and but imperfectly suited the sounds of the borrowing language. None was made for all mankind; none was devised and none is adapted for the whole world. To-day in the new era after the war, the world needs an alphabet, a universal alphabet, a world-alphabet, a standard set of signs, characters or letters, full and complete, so that every sound used by any collection of human beings to indicate (alone or with other sounds) an idea, or to form a word of spoken language or dialect, shall be represented by one letter and only one letter; and so that every such letter shall stand for one and for only one sound.

The Roman alphabet which we and much of western and southern Europe uses, the Gothic, used (not to the exclusion of, but rather concurrently with Roman) by Germans and some Scandinavians, the Greek of Greece, etc., the Cyrillic of Russia and other peoples, the Gaelic, the Anglo-Saxon futhorc, the many cursive characters of Arabic, the Indian alphabets, the ideographs of the Orient, the special alphabets devised for aboriginal tribes of America, Africa and elsewhere—none meets the requirements set out above for a universal, world-alphabet. Such standard alphabet must be a scientific creation, or adaptation and adoption from present alphabets.

In the reorganization of the world at this time, a world conference of scholars and students, versed in many lines of art and science, should be held to devise and present a world-alphabet for consideration and adoption.

J. C. Ruppenthal

Washington, D. C.
(Russell, Kans.)

NONSILVERABLE CONTAINERS FOR SILVERING MIRRORS

Under this title[1] the writer has recently called attention to the observation that certain samples of "granite ware" enamelled iron pans did not seem to attract silver, in the ordinary process of silvering glass mirrors. However, it was not intended to convey the idea that one would expect this to hold true as a general rule.

Just why these pans did not take on a coat of silver while certain white enamelled pans did receive a thick coat of silver, is not understood—as is true of a great many other phenomena observed in attempting to deposit silver chemically upon glass. For example, it has been found easier to silver optical (white crown) glass than a certain mirror made of ordinary plate glass. One concave mirror, which is made of ordinary glass, always shows a spot where the deposit of silver is different from the rest of the surface, even after making a special effort in polishing and cleaning the glass surface. Again, making a container by tying a rim of clean writing paper around the edge of a glass disk, good mirrors were pro-

[1] Science, 48, p. 345, 1918.

duced; but no silver was deposited on the paper. Washing the glass with a certain kind of soap appears to interfere with the silvering process; while another kind of soap seems to be as effective as caustic potash.

Using a glass container, partially filled with the silvering solution, then (after the deposition of silver had started) filling the container with solution it was found on completion of the operation, that but little silver had deposited on the upper half of the container. The line of demarcation was sharp, just as though, once the deposition of silver had begun, the metal was attracted more readily to that part, of the receptacle. To conclude, it seems worth while to find a container that will not attract silver.

W. W. COBLENTZ

WASHINGTON, D. C.,
January 6, 1919

SYSTEMATIC PAPERS PUBLISHED IN THE GERMAN LANGUAGE

MY friend, Dr. W. T. Holland, has sent me copies of his article on the above subject in SCIENCE of November 8.

We are all agreed in our wish for the advance of knowledge and that the "eternal verities" are the only thing that will count in the long run; but in zoology the Russian, Hungarian, Japanese and other languages have never been recognized and I can not think that Dr. Holland himself would recognize descriptions published in the language he cites—Choctau. German is, without doubt, a barbarous language only just emerging from the stage of the primitive Gothic character, and I venture to suggest that it would be to the advantage of science to treat it as such from the date August 1, 1914. The science of botany is in many ways in advance of zoology. At the Botanical Congress at Vienna in 1905 men of Russian and various other nationalities objected to their languages not being recognized in science and it was found that the only method of arriving at an agreement was to insist on a Latin diagnosis being added in systematic papers in all languages, and this was agreed to. This regulation, though it has obvious disadvantages, may be found necessary in zoology also, the only alternative that I can see being descriptions in either English or French, the language of diplomacy. In recent Japanese works on entomology an English description is always added to the Japanese text.

G. F. HAMPSON

62 STANHOPE GARDENS,
LONDON, S.W.

SCIENTIFIC BOOKS

A Synopsis of the Bats of California. By HILDA WOOD GRINNELL. University of California Publications in Zoology, Vol. 17, No. 12, pp. 223–404, pls. 14–24, 24 figs. in text. January 31, 1918.

This work constitutes a notable contribution to the literature of California mammalogy and is characterized by the minute detail, thoroughness of treatment, and painstaking accuracy which one has come to expect in the publications of the Museum of Vertebrate Zoology of the University of California.

Following the introduction, the treatment is taken up under main headings as follows: Senses of bats, habits, voice, enemies, economic value, origin, geographic distribution, dentition, coloration, age-variation, sexual variation, nomenclature, classification, keys for identification, and table of comparative measurements, followed by treatment of the thirty-one forms belonging to eleven genera and three families of bats represented within the geographic limits of California.

Under each specific or subspecific heading appears a full annotated synonymy embracing the nomenclatural changes leading up to the name in current use and all references to the form as occurring in California. The particular species or subspecies is then discussed under the headings, diagnosis, description (including head, limbs and membranes, pelage, color, skull, teeth, measurements), synonymy and history, distribution, specimens examined, and finally natural history.

Data on senses and habits of bats are presented, chiefly compiled from the work of Halm, Ackert, Merriam, Miller, Howell and others, but supplemented by original observa-

tions by the author and her associates. In connection with habits the author states (p. 232) "The habits of our California bats are, unfortunately, but little known. The time and extent of the breeding season, migration and hibernation, the choice of diurnal retreats, and favorite feeding grounds, the methods of securing and devouring prey, the nature of the food, the economic value of bats—these are only a few of the many points on which data are as yet almost wholly lacking."

In connection with breeding habits and enemies, no mention is made of the interesting difference in numbers of young between crevice-inhabiting bats and certain tree-inhabiting species. As is well known *Nycteris cinereus* and *Nycteris borealis,* tree inhabiting forms, have from two to four young, while crevice and cave-inhabiting species have only one or two. As implied by Nelson[1] this seems to be due to the increased risk from the habitat relations of the tree-living forms. An augmented mortality probably results also from the migratory habit of *Nycteris.*

That bats deserve protection for their yeoman service in destroying insects goes without saying. It seems probable, however, that Campbell's estimate of the value of their work in Texas in destroying mosquitoes and thereby reducing malaria, quoted by Mrs. Grinnell on pages 238–239, is exaggerated. Stomach examinations of *Nyctinomus mexicanus* have shown many insects, but mosquitoes only rarely.[2]

The most adequate statement regarding the relation of bats to geographical distribution which has been seen by the reviewer is made by Mrs. Grinnell (pp. 242, 243), who emphasizes the fact that "conditions of temperature and humidity limit the distribution of bats as strictly as they do that of other groups of mammals. In California there is not a single obvious barrier to the distribution of any species of bat; yet not one of the thirty-one forms inhabiting the state has been found to be distributed uniformly throughout the entire area."

1 *National Geographic Magazine,* May, 1918, p. 491.

2 See E. W. Nelson, *National Geographic Magazine,* May, 1918, p. 492.

A study of the dates of capture of *Nycteris borealis teliotis* leads, according to our author, to the inference that "the sexes separate during the summer months, the females remaining in the Lower Sonoran zone, while the males migrate into the Upper Sonoran and Transition zones (p. 326)." After reference to a similar withdrawal from the breeding grounds by the males of certain species of birds, Mrs. Grinnell suggests that "Their departure relieves congestion in the nesting area and leaves a greater food supply for the females and young." In the case of red bats in California, however, one can not readily concede the implications either of congestion in their breeding area or the necessity, with an insectivorous species of the sort, for a greater food supply in summer; but the discovery of the separation of the sexes as noted, if confirmed with the acquisition of more material, is most interesting whatever its explanation.

There are no descriptions of new forms. New locality records are published for nearly every California species and subspecies. Subspecies *altipetens* H. W. Grinnell of *Myotis* is here referred to species *lucifugus* rather than *yumanensis* as originally described. *Myotis lucifugus alascensis* Miller is for the first time recorded from California, a specimen having been taken at Eureka. Definite records of occurrence in California of *Myotis lucifugus interior* Miller are also published for the first time. *Antrozous pacificus* Merriam is accorded full specific rank instead of being regarded as a subspecies of *pallidus.*

The paper is generously illustrated with half tones and maps. Life studies of several species appear, and comparisons of dorsal and lateral outlines of bat crania are made possible by an extensive series of enlargements. A few well executed line drawings show particular external characteristics of bats, and clear maps indicate the geographic ranges within California of all the forms considered.

A carefully prepared bibliography of 110 titles furnishes a ready key to the most important contributions to the literature.

One can but wish that the policy of the editors of the University of California Publications in Zoology provided for an index to individual papers, at least of the size of this one. This book, with no index, will probably be used as a separate publication by ten persons to one who will ever have occasion to consult it as bound in the volumes of the Publications in Zoology.

WALTER P. TAYLOR

BUREAU OF BIOLOGICAL SURVEY

BOTANICAL ABSTRACTS

THE plan of organization of a permanent board of control of botanical abstracts as outlined in the columns of this journal,[1] was effected at the Southern Hotel in Baltimore, on December 29, 1918. A joint meeting was held of the members of the temporary board, of the permanent board and of the board of editors at which was discussed many of the problems arising in connection with the undertaking. The following persons were present: A. F. Blakeslee, H. C. Cowles, B. M. Davis, B. M. Duggar, C. S. Gager, J. M. Greenman, A. S. Hitchcock, O. E. Jennings, B. E. Livingston, D. T. McDougal, Geo. E. Nichols, E. W. Olive, D. Reddick, J. R. Schramm and E. W. Sinnott.

The permanent board of control, which consists of two representatives elected from each of the allied societies, began functioning at this meeting. Some societies have been unable to hold a meeting at which representatives could be elected so that the following list represents the board as at present constituted:[2] American Association for the Advancement of Science, Section G, B. E. Livingston (4), A. F. Blakeslee (2); Botanical Society of America, Physiological Section, B. M. Duggar (4), W. J. Osterhout (2), Morphological Section, B. M. Davis (4), R. A. Harper (2), Systematic Section, J. H. Barnhart (4), A. S. Hitchcock (2); American Society of Naturalists, E. M. East (4), J. Arthur Harris (2); Ecological Society of America, Forrest Shreve (4), Geo. H. Nichols (2); American Phytopathological Society, D. Reddick (4), C. L. Shear (2); Paleontological Society of America, E. W. Berry (4), F. H. Knowlton (2); Society of American Foresters, J. S. Illick (4), Barrington Moore (2); Society for Horticultural Science.

The following actions were taken. They do not constitute the exact minutes of the meeting but are a codification of them with the omission of matters of ephemeral consequence. The temporary board of control was called to order at nine o'clock. It was voted unanimously that retiring members of the permanent board of control be not eligible for immediate reelection. The permanent board was thereupon organized with Donald Reddick and J. R. Schramm as temporary chairman and secretary, respectively.

Vote by ballot resulted in the election of Donald Reddick as chairman of the board of control of botanical abstracts. It was voted that an executive committee of five including the chairman be named by the chair, in consultation with the secretary. Drs. Harper, Livingston, Nichols and Shear were named. It was voted that the executive committee act as a committee on policy and make recommendations to the board of control prior to the annual meetings. Also that it attend to all *ad interim* business not involving change of policy.

The executive committee was given instructions as follows: (1) To incorporate the board of control of botanical abstracts; (2) to close a five-year printing and publishing contract with the Williams & Wilkins Co. of Baltimore; (3) to select editors for the sections for 1919, including those sections not now provided for; (4) to study and make a report at the next annual meeting on the arrangement of sections present within a fortnight to the botanical representative of the committee on grants of with reference to mycology; (5) to prepare and

[1] June 7, 1918, p. 558.

[2] The term of some members expires in two years and of others in four years, as indicated, but at the meetings of December, 1920, a new member will be elected by each of the participating societies for a term of four years, and such elections will be biennial thereafter.

the American Association for the Advancement of Science an application for a grant of funds. (Pursuant to an action taken by botanists at the dinner for all botanists.)

It was voted that the executive committee be informed that it is the consensus of opinion of the group present that the sections "bacteriology" and "cytology" be abandoned with the definite understanding that abstracts of articles in these fields be cared for by the other sections.

It was voted to appoint a committee, not confined to the board, whose duty it should be to prepare a list of all serials containing material to be abstracted for *Botanical Abstracts* and to appoint collaborators for such serials. J. R. Schramm was appointed chairman of the committee with power to select other members.

It was voted that the matter of including abstracts of zoological literature in *Botanical Abstracts* be left for the present to the discretion of the several editors, and that it be suggested to the committee that it limit its lists largely to plant literature.

Adjournment taken at three o'clock.

J. R. Schramm,
Temporary Secretary of the Board of Control of Bot. Absts.

SPECIAL ARTICLES

NON-SPECIFIC PROTEIN ANTIGENS PREPARED FROM SHATTERED HEMO-PROTEINS

For some time past I have been in quest of new methods to aid in combating various infections. I have tried out inhalations of several gases, hypodermic and intravenous injections of several salts and bases and acids, with practical negative results. However, recently I have obtained some very promising results while working upon the following hypothesis: In the blood and the blood-forming organs one may find the various compounds from which the building stones from which the various anti-bodies are formed during the process of active immunity to infection. Therefore the blood, or blood-forming organs may be the best material in which to find chemical compounds which may be isolated and used artificially to help the body resist infection. The blood in all probability contains the compounds which, when broken down to just the proper state of division, would yield a large number of proteins of relatively small molecular weight, which might act as antigens when introduced into the blood stream. The number and variety of these shattered products of blood digestion are doubtless very great, and some of them might well do the work of an antigen for almost any infection. In short, if the blood were properly digested and the various fragments of the digested blood tried out, it might be possible to find compounds which would not act harmfully in any way but would act as antigens in a great variety of infections.

In order to shatter the protein of the blood without destroying the particles it seemed best to employ no strong acids nor strong alkalis, nor any alcohol; but instead to use natural digestive enzymes. As a preliminary experiment I used Witte's peptone as a source for obtaining these shattered proteins. This worked very well, for Witte's peptone, being made from peptic digestion of blood fibrin proved to be very rich in these protein bodies. After trying Witte's peptone I prepared my own peptone and from that prepared my protein, from the fibrin of ox-blood by digestion with hydrochloric acid and pepsin. This method seems to be satisfactory. After the mixture of protein is prepared, it is separated into various parts such as primary and secondary proteoses and peptones. A mixture of secondary proteoses constitutes the protein we have used. The protein fractions were separated by precipitation with ammonium sulphate, the lower fractions being used, the other fractions rejected.

After long and careful testing on animals I have been using the protein in collaboration with clinical men on several different infections. Although the clinical side of the work has been going forward for over a year, in most diseases we are still far from a definite conclusion. However, Dr. Stanton and myself working on acute and chronic arthritis have found out that the protein is a very powerful remedy. It has given uniformly successful results on almost one hundred cases. Some of these were acute and others were chronic cases of years

standing. In collaboration with some of my pupils and other clinical men we have tested the protein in various streptococcus infections with good clinical results. More recently we have been extending the work to influenza, tuberculosis, pneumonia and all kinds of infections.

We do not yet know the exact compounds contained in the mixture of proteins which we have been using. There seems to be reason to believe that it is a rich mixture of many different individual proteins. We are making an effort to identify them as far as possible. It may be that the complexity of the mixture is the source of its power in so many different infections. We are also pursuing the inquiry as to the various possibilities of preparing other proteins from blood producing tissues and testing out on those infections which do not yield to the present protein.

I hope soon to publish a more complete account of the chemical work concerned with this problem and also of the clinical results obtained.

Clyde Brooks
The Ohio State University

A BIO-CHEMICAL THEORY OF THE ORIGIN OF INDIANAITE

Indianaite is the name applied to a variety of halloysite (Dana) by E. T. Cox.[1] It is a white mineral of porcelain-like appearance occurring in Indiana in beds varying in thickness from a few inches to eleven feet in rocks of the Mississippian and Pennsylvanian groups. Leo Lesquereux suggested that it had been formed by the burning out of a bed of coal.[2] Cox[3] advanced the theory that the Indianaite had been formed by the weathering and dissolution of a bed of limestone.

From studies in the field and laboratory the writer is convinced that the origin is due to bio-chemical action. Briefly stated the process is as follows: Shales containing pyrite are weathered and sulphuric acid is produced. The sulphuric acid attacks the clay forming aluminum sulphate. Sulphur bacteria absorb the soluble alum and rob it of its sulphur, secreting the aluminium in the form of a hydrated aluminium silicate which by a partial dehydration is rendered insoluble thus forming Indianaite. The writer has isolated the bacteria and finds them to be similar in appearance to *Beggiatoa alba*. That these microorganisms are influential in the origin of the Indianaite the writer believes he has demonstrated by experiments in the laboratory.

William N. Logan
Indiana University

1 See 6th Ann. Rept. Geol. Sur. Indiana, p. 15.

2 See Rept. of a Geol. Reconn. of Indiana, 1862, p. 320.

3 *Loc. cit.*

THE AMERICAN PHYSICAL SOCIETY

The ninety-fifth meeting (the twentieth annual meeting) of the American Physical Society was held at Johns Hopkins University, in Baltimore, Maryland, on December 27 and 28, 1918, in affiliation with Section B—Physics, of the American Association for the Advancement of Science. Professor Bumstead is now serving as scientific attaché to the American Embassy in London and his resignation as president of the society was accepted by the council on November 30, 1918. The vice-president, J. S. Ames, thus became acting-president, and he presided at the several sessions of the society and the council. The maximum attendance at the technical meetings was about one hundred, while eighty-eight members and visitors were present at the time of the business session.

On the afternoon of December 27 there were two sessions under the auspices of Section B, the presiding officer being the vice-president and chairman of the section, Major G. F. Hull. At 2 o'clock, P.M., the retiring vice-president and chairman, W. J. Humphreys, gave an address on "Some recent contributions to the physics of the air." At five o'clock, P.M., Dr. George E. Hale gave an address before the entire association on "The National Research Council."

The annual business meeting was held at eleven o'clock, A.M., on December 28, 1918. The revised form of the constitution and by-laws was unanimously adopted by letter ballot. The amendments do not alter the intent or purpose of the constitution in the old form, except in one respect: the managing editor is made a member, *ex-officio*, of the council. The amended constitution will be published in the next printed list of members.

The following officers were elected for the year 1919:

President—J. S. Ames.

Vice-president—W. C. Sabine.

Secretary—D. C. Miller.

Treasurer—G. B. Pegram.

Members of the Council (four year term)—G. K. Burgess, J. C. McLennon.

Member of the Council (one year, unexpired term)—Max Mason.

Members of the Board of Editors of the Physical Review—Henry Crew, L. V. King, H. S. Uhler.

Colonel Millikan explained the purposes of the Smith-Howard Bill now before Congress, authorizing federal cooperation with the states for the promotion of engineering and industrial research. After general discussion it was unanimously voted that the American Physical Society favors federal aid and cooperation with the several states in support of research in science and engineering and in industrial research. The society favors the creation of boards of eminent scientists and engineers within each state for the administration of the funds appropriated for all research within the state.

At the morning sessions of December 27 and 28, 1918, thirty papers were presented as follows, four being read by title:

The unique system of units: W. W. Strong.

A simple stretched wire dilatometer: Arthur W. Gray.

Monochromatic and neutral tint screens in optical pyrometry: W. E. Forsythe.

The temperature, pressure, and density of the atmosphere in the region of northern France: W. J. Humphreys.

Refinements in spherometry: G. W. Moffitt.

A new type of hot wire anemometer: T. S. Taylor.

The linear thermal expansion of glass at high temperatures: C. G. Peters.

Some characteristics of glasses in the annealing range: A. Q. Tool and J. Valasek.

Striæ in optical glass: L. E. Dodd and A. R. Payne.

Preliminary determination of the thermal expansion of molybdenum: Lloyd W. Schadd and Peter Hidnert.

On the characteristics of electrically operated tuning forks: H. M. Dadourian. (Read by title.)

Ionization and resonance potentials for electrons in vapors of arsenic, rubidium and cæsium: Paul D. Foote, O. Rognley and F. L. Mohler.

Absorption coefficient of the penetrating radiation: Oliver H. Gish.

Photoelectric sensitivity vs. current rectification in molybdenite: W. W. Coblentz and Louise S. McDowell.

A device for the automatic registration of the α- and β-particles and γ-ray pulses: Alois F. Kovarik.

Note on the distribution of energy in the visible spectrum of a cylindrical acetylene flame: Edward P. Hyde, W. E. Forsythe and F. E. Cady.

Preliminary note on the luminescence of the rare earths: E. L. Nichols, D. T. Wilber and F. G. Wick.

On the critical absorption frequencies of chemical elements of high atomic numbers: William Duane and Takio Shimizu.

Some interesting results of eclipse magnetic observations: L. A. Bauer.

The minimum temperature at the base of the stratosphere: W. J. Humphreys. (Read by title.)

Why clouds never form in the stratosphere: W. J. Humphreys. (Read by title.)

Speeds in signaling by the use of light: W. E. Forsythe.

Thermal conductivity of various materials: T. S. Taylor.

Further observations on the production of metallic spectra by cathode luminescence: Edna Carter and Arthur S. King.

Effect of crystal structure upon photoelectric sensitivity: W. W. Coblentz. (Read by title.)

A mechanically blown wind instrument: A. G. Webster.

The dynamics of the rifle fired at the shoulder: A. G. Webster.

Interior ballistics, by a new gun indicator: A. G. Webster.

Residual gases in highly exhausted glass bulbs: J. F. Shrader.

Silvering quartz fibers by cathodic sputtering: J. F. Shrader.

Dayton C. Miller,
Secretary

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SOME RESPONSIBILITIES OF BOTANICAL SCIENCE[1]

WHEN this meeting of the American Association for the Advancement of Science was first announced it was the expectation of all of us that our discussions and deliberations here would center primarily about the immediate and practical needs of a time of war. In those days the thought seemed common in this country, that it was the plain duty of scientists to lay their more remote aims aside for the time being and to devote their energies almost entirely to practicalities, the practicalities of those great martial undertakings whose wonderfully successful results have only just now passed into history. But it has become clear that the needs of a modern militant nation are not merely men and money; the ramifications of these needs seem to have led into nearly every cranny of human activity, so that almost every person has found ways by which his special fitness, for some activities rather than for others, might be utilized in this grand mobilization of the nation as a whole. In very many cases it has appeared that the more remote aims of those whose activities are primarily intellectual and spiritual are not to be laid wholly aside at the sounding of the trumpet of war and at the waving of the battle flag. It has emerged that most or all of those activities that may truthfully be called essential for peace and for the general advancement, are also essential in time of war. Details have required alteration, but the war has led, on the whole, rather to an acceleration, to a speeding-up of the majority of productive peace activities, rather than to the laying of such activities aside.

War differs from peace rather in degree than

[1] Address of the chairman and vice-president of Section G—Botany, American Association for the Advancement of Science, Baltimore, December, 1918.

in kind. It calls for a mobilization—which is a planned cooperation—of all the valuable and worthy activities of the nation. And just such a mobilization was proceeding with ever-increasing strides in this country, until the news of the present armistice announced the need for still further changes of detail. Let us hope that the spirit of planned activity, aroused from the magic lamp of human nature by the rubbing of a martial hand, may not be sent to rest with the return of peace. The civilized world has found again that the greatest human pleasures and satisfactions may come from the giving of money and goods and heart-beats and even the life-blood of many individuals, all for the furthering of the same worthy cause. It has found that national and world mobilization are the means whereby great works may be rapidly achieved, it has found that cooperation between individuals and between states is the means whereby the pleasures of the accomplishment of such works are to be most quickly attained. In order that we and those who follow us may enjoy these great pleasures of accomplishment, let us strive to keep the spirit of cooperation alive and aggressively active against the false demons of the more primitive and more frequently prevailing forms of selfishness, and let us move forward, with this spirit in our hearts, into the era that is now dawning.

The burden of my words to you this afternoon will be to ask you to pass, for a few minutes, out of the work-a-day world of selfish struggles for "credit" or "priority" in scientific literature, or for salary increase and the like of that, out of the world of minute detail with its microscope lenses and balance pans, and to dwell for a little while on some of the larger possibilities and opportunities that lie before botanical science at this time. And I shall wish to emphasize the idea that, for a goodly number of us, at any rate, these possibilities and opportunities are tasks and responsibilities that really and truly need to be met.

It is well first to realize that those who devote their lives to science have peculiar responsibilities. The body of human knowledge has grown apace and constitutes our most cherished possession. It alone can be handed on to the coming generations; other human achievements wear out and disintegrate with time, while knowledge lasts and grows and increases in value as our race matures. Whatever may be your idea of the final good of human life, whether it be to glorify God or wallop the devil, to give ourselves pleasure in the present or in the future, or to give to coming generations a better chance to live as they will wish to live—no matter at what particular angle you may view these academic questions of ultimate results, you will surely agree that the preservation of real knowledge is one of our responsibilities. We and our posterity will have great need for all the knowledge that is available, to-morrow and the day after, and one of our world responsibilities is clearly to see that knowledge once gained shall not be lost.

But this is not all. It is not sufficient for a healthy human being to act merely as a vestal, simply to keep a torch burning that was kindled by others. It is our instinct to increase the body of science as well as to preserve what has been accomplished, and instinct appears to accord with reason here, for if knowledge is valuable it should be increased as rapidly as possible. This is, then, another of our world-responsibilities.

To preserve for the future all that is known of ourselves and of the universe about us, to make this knowledge ever more readily available, and to add to the store as we work it over and hand it on to others, these seem to be the prime responsibilities of human beings, as distinguished from other organisms. Now, if these things are to be done there is no group of society so fitted to do them as is the group of scientists; upon them has fallen the mantle of the vestal and that of the priest. Society, as a whole, relies on scientists for these things and these responsibilities are especially ours.

It has frequently seemed to me that we, as a group, fulfill these requirements with a maximum of friction and waste and with a minimum of efficiency. At least it is not difficult for a dreamer or an idealist to suggest general

ways by which our service to humanity might be greatly enhanced. If improvements might be introduced each individual might find more pleasure than is now possible, in his own work and in that of the group, and it seems just now to be an opportune time to take some thought as to possible ways by which our social function as scientists may become more satisfactory, both to ourselves and to those outside of our group. A kind of idealism has succeeded in winning the war, and he who runs may read that this was a war of science, and that it was through science that it was finally won. Consequently, I may not be too bold if I here pass in review some of the suggestions for an improved science that have come to me in one way or another.

In the first place, ever since my student days it has seemed very strange to me that the devotees of science lay so little stress on the broader and more general aspects of their work and upon the aims that are held in view. Our introductory books plunge the beginner into a maze of concrete detail, without attending to the orientation that every beginner needs. Our teaching of beginners follows our texts, or else our texts follow our teaching. We imply that this general orientation, this appreciation of the relations between our particular small chapter of science and the great body of human knowledge, will care for itself, without conscious attention. We see that our students learn how to weigh a seed or how to stain a chromosome, and we strive to give them a digest of all that is so far known of seeds or chromosomes, but it is only seldom that the very need for such knowledge receives adequate attention. I am not sure whether botanical science is to be criticized more in this respect than other branches, but I am sure that the criticism is justly to be considered by botanists of all sorts.

Obviously the matter has lain largely in a lack of *esprit du corps* among botanists; we have largely failed to be conscious of our responsibility as a group. We have not taken the trouble to find out what we can agree on, and an outsider feels that we can not agree on anything at all. As the late Professor Bessey remarked of botanical research, the work of botanical science is carried on by a sort of guerilla warfare, each botanist for himself. To speed up our work in all lines we need more team-play, as it were. We need to have somewhat clearly in mind what, indeed, our activities are all about. If we might attend to these matters of orientation we ought to be able, then, to emphasize certain sorts of work that are to be regarded as the more important, for the present.

The answer to the question as to how guerilla warfare, without *esprit du corps* and without conscious aims, is to be metamorphosed into a planned and productive campaign, lies, I am almost certain, in the connotation of the word cooperation. As we mobilized ourselves and laid aside our individual differences of opinion or faith, in order to help in the winning of the war, even so (if we thought it important enough) we might mobilize ourselves for the rational acceleration of the work of botanical and other sciences. One of our greatest responsibilities right now is to orient ourselves as a group and to plan our campaign of work for the immediate future.

The group of botanists is an international group and our mobilization should aim to be international finally, but it were well if the botanists of this country might put their own house in order as a first move toward the setting up of conscious aims and planned campaigns by the world group. In the meantime, botanical scientists of other countries may be doing likewise, and the International Association, or some other organization, might become the means of bringing the national groups into a single whole.

Turning to matters a little more concrete, I suggest that there are two quite different kinds of aims or objects, toward which we may strive. The first of these has to do with our responsibility to *preserve* botanical knowledge, to make it available for all sorts of application, and to pass it on to the next and later generations. The second kind of aim deals with our responsibility, to *add to* botan-

ical knowledge. I should like to consider certain ideas with reference to each of these two general aims.

The Conservation of Knowledge Already Attained.—My first topic, on the conservation and presentation of knowledge already at hand, involves the teaching of students and the publishing of résumés, year-books, abstract journals, and the like. The teaching aspect I shall not venture to take up here; the atmosphere is at present somewhat hazy with discussions on botanical, zoological and biological teaching, questionnaires on these topics flit frequently through the mails, and this whole matter seems to be receiving considerable attention at the hands of teaching botanists. Also, it seems well for your vice-president to take no sides on these questions at present, especially as he does not count himself a teacher (excepting for the purposes of army draft questionnaires!) and has not taught beginners for many years.

On the other hand, I do wish to ask your consideration of several ideas bearing on the preservation of botanical knowledge and the rendering of it available to those who wish to use it in some way. You have all appreciated the fact that the storing and handling of scientific knowledge (as represented by the literature, and to some extent by herbarium and museum specimens) has recently become of the utmost importance. Botanical science is now so broad, and its wealth of knowledge is so great, that no worker can hope to read nearly all the papers appearing in his own field, to say nothing of those in related fields. It thus comes about that valuable bits of knowledge get lost in the pile, as it were, and fail to reach those persons who would be able to use them. It is a favorite "indoor sport" for scientists to find fault with their colleagues because the latter are not suitably familiar with the literature, but the critic is generally as lame as the poor cripple he derides. As I have remarked elsewhere, "science is in great danger of obliterating itself under its own productions, poisoning itself with its own excretions, like yeast." It is a very serious research to find out what is already known about any given topic, and matters grow daily worse.

Abstract journals can help greatly in this difficulty, and we are trying to improve conditions by starting *Botanical Abstracts,* an enterprise that is a cooperation of a large number of workers in botanical science "in its broadest sense." Some botanical journals, like the *Revue générale de Botanique* and the *Plant World,* occasionally publish résumés of the present status of knowledge regarding some limited topic. These are of great value if accompanied by accurate citations, and their number should be increased. Sometimes journals publish monographs more complete than résumés; for example, Jörgensen and Stiles' monograph on "Carbon Assimilation," which appeared in the *New Phytologist.* Such contributions should be encouraged, especially when they represent the cooperation of a number of workers and are accompanied by full and accurate citations. But, from apparently authoritative discussions of the status of a scientific field, by a single author and without citations of the literature, may whatever gods there be left deliver us!

But it needs to be emphasized that all these things are but makeshifts. We need to step forward boldly and state that our science, as well as all the others, needs, and needs very much, a *national or international institute for the furnishing of bibliographical information on request.* Such an institute would of course be a great undertaking, even for a field as narrow as botanical science, but it might well be the most productive investment that science (or humanity as a whole, even) could now make. It has been suggested that the establishment of such an institute for this country might well be by the National Research Council (which has been made permanent as you know), under the auspices of the National Academy of Sciences. And it has also been suggested that this proposed institute become the avatar of all those vague longings that find voice from time to time in pleas for a national university of some sort. Such an institute would have its permanent staff of departmental heads and its corps of

bibliographical assistants, but it would seek to have the full cooperation of all scientists. It would undertake to furnish bibliographies on any topic, with or without abstracts, and within reasonable time. I suspect that an organization of this kind might pay a good portion of its current expenses, through fees charged for the work done.— I might follow this dream into further detail, but I imagine the time is not yet ripe for that, what I wish to do here is to leave you with a very clear impression that this suggestion has great promise, that it is quite within the realm of possibility, and that it may ultimately be realized if we can unite in calling for it. It would avoid enormous wastes of time and energy on the part of many scientific workers and research institutions, and it would give congenial and dignified employment to many who wish to serve in scientific work but who may not find their best places as teachers or research workers.

Botanical Research.—Regarding research itself, and how we may best mobilize our limited strength so as to accelerate the advance of knowledge as much as may be, I shall confine my suggestions to three general topics: (*a*) the planning of research, (*b*) the procuring of data, and (*c*) the interpretation and presentation of results. But before we turn to the consideration of such suggestions as I may offer here, I ask your attention to two very striking characteristics of scientific research in general. First, scientific research is not recognized as an occupation or profession. We speak of research workers and emphasize the great value of their work to mankind, but the draft questionnaire (presumably the result of a number of able minds attempting to classify the possible occupations of our citizens) failed to show any such occupation. You might be a farmer or a blacksmith or a chauffeur, you might be a lawyer or a physician or a preacher, but you could not legally be a research worker or scientific investigator! An investigator in physiology might call himself a *teacher*—for he surely has to tell others about his findings—but this was misleading unless an explanation was made. On the other hand, he might call himself an agricultural worker, engaged in an agricultural enterprise—since his physiological studies may frequently have something to do with agricultural plants—but this also was misleading and suggested familiarity with plows and manure-forks rather than with laboratory apparatus of precision.

My reason for introducing this somewhat startling observation is to call attention to the fact that scientific research is unorganized and unrecognized as a reputable occupation. Galileo had to steal away and perform his experiments in secret, on account of a devilishly inquisitive church, Leonardo had to get time for his researches between trips to the ducal palace to do odd jobs of repairing the plumbing and such-like things, and it appears that modern science has left this whole matter of research in much the same condition as that in which it was in those old times. A teacher may obtain some time for research between elementary classes in arithmetic or agronomy, a lawyer may carry on research on Sundays and holidays, but you must admit that, for the most part, scientific research is left to individual activity and is not sufficiently recognized to warrant official mention!

This is the more notable when we recall that the educational aspect of scientific responsibility is very thoroughly organized and largely standardized, with great government support of many kinds and with enormous endowments supporting libraries, museums, lectures. We have public recognition of the fact that knowledge is to be carefully preserved and passed on in available form to coming generations, but it is not as yet practically recognized that it is anybody's main business in life to increase knowledge through investigation.—It is a noteworthy fact that research is frequently expected of college and university teachers, that they are frequently appointed on the basis of published papers presenting the results of research, and it is just as noteworthy that such a teacher must generally carry on his investigations in a surreptitious way; his teaching activities are recognized but his research activities are not, even though their

results are expected and even demanded. In purchasing laboratory equipment for research it has indeed happened sometimes,—so I am told,—that research apparatus has been purchased under the false pretense that it was needed in teaching! If botanical research is one of our responsibilities as botanists, I submit that this anomaly demands some serious attention.

The other striking characteristic of much of our scientific research is this, that most of the published work appears to be done by *apprentices*. I refer to publications by beginners, like dissertations for the doctorate of philosophy in our universities. I can think of no other line of important human activity in which the work of apprentices looms so large as it does in botanical and other sciences. This state of affairs would not be so bad if the leaders under whose guidance the work has been done could take enough part in it to save the publications from the verge of futility. As would be expected of apprentice work, these publications frequently show poor planning and more frequently poor interpretation. The gathering of data may be well done, within the limits set by the plans. There seem to be some possible ways out of this difficulty, but I shall not take time here to mention even the ones I have had in mind.—I turn now to my three phases or aspects of research.

(*a*) *The Planning of Research.*—It has seemed to me that the planning of scientific investigation deserves very much more attention than it generally receives. Not having any clear aims, we are apt to be misled to the erroneous idea that all sorts of research are of equal importance. Perhaps it is not any longer fashionable to tell students that the mere gathering of facts in *any* field constitutes valuable scientific work, but we surely have not passed far beyond the conception that a personal and capricious interest is a proper and respectable guide in the choosing of a problem and in determining how it is to be carried out. It often seems that each worker brings forward his contributions without any notion as to how they are to fit into the structure of the science as a whole. It is somewhat as though each of us brought what he happened to have and threw it on a large and heterogeneous pile, hoping that a rational structure might, by some unknown means, be builded therefrom. We seem to feel little or no responsibility in the building itself, we bring contributions that can not be used at present and we let the building operations stop at many points because we do not bring the materials that are immediately needed.

A well-selected problem does not always mean a well-planned investigation, however; and an opportune problem has often led to great waste of time and work simply because the method of attack was hurriedly decided upon. As you have surely observed, experimental and observational investigation, as it is published, frequently shows what almost seems to be a genius for omitting the needed experimental controls. Again, things that are of relatively small importance are often dwelt on with great care, while the most outstanding points are woefully neglected. Needs that should have been cared for in the preliminary plan are often not appreciated until the experimental or observational work is completed, when it is too late to mend matters.

I have been led to think that this condition of affairs is largely due to a still more or less prevalent and very insidious fallacy, to the effect that a scientific investigator can not hope to find out what he sets out to find out, but has to drift with winds and currents and gather in the observations and results that he happens to run across. It is sometimes the business of a pioneer explorer to work in this way, but I think we should hardly call that sort of work scientific research in the modern sense. Discoveries of *facts* may be made now and then by chance and intuition, but discoveries of *relations* (with which our science now mostly deals) are largely to be made by taking serious thought as to just what we need to do in order to find out just what we set about finding out.

You have been warned earlier in this address of the fact that I regard cooperation as the touchstone by which we may hope to cure,

or at least alleviate, many of our scientific ills, and you will at once see that our selection of problems and our planning of projected investigations would be greatly improved if cooperation between competent thinkers were more in vogue. If every projected research involving considerable expenditure of money and energy might be submitted to several competent workers, with the request that they make suggestions, I have no doubt that much more valuable and feasible plans might result. It strikes one as a curious fact that scientific investigators wish to keep their work secret until it is finished (as they may fondly suppose), after which they are just as strong in their wish to present it to their colleagues. The results of investigation are frequently treated like Christmas gifts; they are planned and made in secret and handed to the recipients only after alterations are well-nigh impossible! And, finally, to complete the anomaly, the investigator is often sorely pained if his contribution proves to be very imperfect or even quite unacceptable! One wishes to ask why it would not be better to obtain the adverse criticism *before* the work was "finished," rather than to wait until after publication; the criticism will eventually be forthcoming in any event and it should be much more useful if it were made available early in the investigation. In so far as in us lies, we should avoid wasting our own time and facilities and those of our colleagues.

As I have emphasized elsewhere, it ought to be of enormous value to botanical science if some organization (perhaps the National Research Council) might publish yearly a list of what seem to be important and promising and feasible problems for botanical investigation, with elaborated plans. My imagination pictures this list as rather long, including all sorts of projects, sent in by numerous thinkers who have the well-being of their science really at heart, and I should expect it to alter from year to year, as projects get undertaken and results are obtained. It would be a fine thing if each society of research workers were to take upon itself the responsibility of furnishing such a series of proposals. This should be accompanied by a usable bibliography of each problem, and mention should be made of investigators who might be engaged in this sort of work.

If this dream might come true such an annual publication might do more toward giving us a rather clear picture of the aims and trend of our science than could be secured from any other simple form of organized cooperative effort.

(*b*) *The Procuring of Data.*—After a research problem has been selected and properly planned, the securing of the requisite observational or experimental data is a matter of comparatively little difficulty. This is the easiest part of investigation and many publications consist of but little more than tabulations or lists of the data secured, without serious attempt to exhibit either plan or interpretation. This phase of research requires special attention less than do the other two and I need not dwell here upon it. I may suggest, however, that when practical difficulties arise during the progress of a piece of experimental or observational work, it would be well for the investigator to call upon some of his competent colleagues for advice, and it would also be well for the rapid advance of our science if the persons thus asked might respond in a whole-hearted sort of way. Let it be remembered in this connection that botany is a world science and that its advance is not to be accelerated through the usual operation of institutional or individual rivalries and jealousies. Such motives may have value if rationally controlled, but they do not appear generally to result in the building up of an *esprit du corps* among scientists.

(*c*) *The Interpretation and Presentation of Results.*—It frequently follows that a good plan systematically carried out gives results that are largely interpreted by the plan itself. If a quarryman cuts an ashlar expressly for a certain position in a wall it is not necessary for him to explain to the builder just what is to be done with it when it is delivered. But the case is not nearly always so simple as this when complicated problems are under investigation. And most biological problems are still

so complicated (largely because they are chosen to embrace too large a field in each case) that special effort is required to find out what may be the meanings of the data at hand.

It appears that comparatively few writers take the trouble to interpret their results in anything like a logically complete manner. Our interpretations are generally hurried and are apt to be biased. Out of a large number of logically possible conclusions we are apt to state but one and to pretend that the facts support this hypothesis more than the others. Indeed, we usually write our discussion from the standpoint of a single one out of several or many logically possible hypotheses. The general result is that our literature abounds in published data which are either uninterpreted or illogically or incompletely interpreted. One of the greatest wastes in biological research lies, to my mind, in the publication of so many uninterpreted observations. To the beginner in research it may seem that a grateful science should be willing to interpret these data if the writer will just present them, but this is found not to occur in practise. As a general rule, if an author does not interpret his own results they remain uninterpreted and are finally lost in the maze of the literature; most active investigators do not like to attempt the study of the logical possibilities suggested by results obtained by some one else, especially as the plan followed in obtaining such results is apt to have been different from what the second investigator might wish to employ. It were better if we performed far fewer experiments and devoted much more time and energy and care to logical planning and thorough interpretations of the results we secure.

Just as in the case of choosing and planning an investigation, so in the case of interpreting observational and experimental data, several brains are preferable to one, and cooperation is greatly to be desired. It seems highly desirable, indeed, that several competent minds might be asked to make suggestions regarding any research, at several times, from its inception to the publication of the resulting contribution. If some of our critics might be asked to criticize our papers before they are published, a great many mistakes and misunderstandings might be avoided and a good deal of personal jealousy and righteous or unrighteous indignation—both of which waste energy and time and money—might be prevented. Some of the standing committees of the Ecological Society of America have arranged for this sort of pre-publication criticism and it promises to be a valuable feature in raising the standard of research publication.

Responsibilities toward Applied Botanical Science.—In working over the mass of botanical knowledge that has already been obtained, for the purpose of presenting it to others, and also in selecting lines along which research is to be undertaken, we shall fail very seriously in the discharge of our responsibility unless we give special attention to the scientific and philosophical aspects of the application of our science to all the various needs of man. In a former publication[2] I have emphasized the fact that what is now commonly called applied science does not include nearly all of the applications of scientific knowledge. I take it that the term applied botany means to most of us *practical* applications in the arts, which serve the physical, esthetic and even the spiritual needs of mankind. Here belong agriculture, forestry, pharmacognosy, floriculture, such arts as dyeing, tanning, spinning, cooking, brewing (I believe there are still breweries somewhere in the world!), and many other important branches of human activity. These may be called practical applications, because they supply material things that are in demand and consequently have pronounced commercial value.

But there is another kind of application that is very important but that may not properly be called practical. I mean those applications that satisfy the intellectual or mental needs of mankind. Thus, chemistry, physics and climatology are applied in botanical science, and this science is in turn applied in chemistry, climatology, geology, psychology, philosophy, and so forth. In default of a better term I may call these *philosophical* applications. Here also belong the applications of one branch of our science to another branch, as

[2] Johns Hopkins University Circular, March, 1917.

when anatomy is applied in physiology, or when physiology is applied in ecology. While the philosophical applications of botany do not "take the eye and have the price" as do its practical applications, yet their value is universally acknowledged to be exceedingly great. They should not be left out of account in our proposals for a renewed mobilization of botanical scientists.

A consideration of these two groups of applications, called here the practical and the philosophical, will furnish a wealth of suggestions for research projects. It is the business of botanical scientists to supply all knowledge about plants that may be enquired for in behalf of any line of human activity. If we do not possess a certain kind of knowledge demanded by an art or another science, surely it is our responsibility to make the needed knowledge by research, and to do so as promptly after the need arises as is possible. Looked at in this way, the prevalent conception of botany as a composite of two different kinds of science, "pure" and "applied," is seen to strike very wide of the mark. In many ways it is to be regretted that many arts that employ applied science have come to be themselves called sciences, thus creating great confusion, but it were hopeless to try now to correct such illogical usages as those of agricultural science, medical science, veterinary science and the like. Agriculture, for example, is not a science, but an art, and whatever of science it employs is applied from botany, zoology, geology, climatology and so forth. (Of course it is understood that if plant physiology or the physiology of the wheat plant is regarded as a part of botany, so must animal physiology and the physiology of man be considered as a part of zoology.)

We are probably all in agreement as to the proposition that by far the greater portion of future botanical investigation will have to do with supplying botanical knowledge to the arts of agriculture, forestry and medicine—and the greatest of these is agriculture. Other speakers at these meeting will probably emphasize the scientific needs of this art—which they may call a science—and I need not here go farther in this connection.

If you agree with me that some of our greatest responsibilities have to do with the supplying of knowledge needed by the arts and the other sciences, and if you also agree that much of our advance is to come through cooperation, it naturally follows that botanical scientists must cooperate not only among themselves but also with workers in other sciences and in the arts.

In conclusion of this address, which may already be too long, I shall not attempt to summarize the various points and suggestions to a somewhat awkward presentation of which you have so kindly and patiently listened. I have voiced a longing for a conscious cooperation among scientists that has been felt by all of us, and I have placed before you a few suggestions as to some paths along which we may hope to proceed toward the realization of this desire. This address lays no claim to logical completeness but I think I may claim for it that it is facing in the right direction. We surely need to appreciate our responsibilities as botanists toward humanity and to take conscious steps toward the organization of rational compaigns against the demons of ignorance and superstition and waste. Now is the time of times, the "zero hour"; let us assume our responsibilities and do our share in the reorganization of human life for the new day that approaches. And let us not get in each other's way nor in the way of other groups of workers. We would give once again to botanical science her "place in the sun," but we would not do this by interposing any hindrances in the paths of the other sciences, with which we have no quarrels. Finally, we would accelerate the growth and unification and organization of our national science, not that we may excel in a national way (with a sort of colossal selfishness of an all-too-common type), but that we may serve world science to our utmost, thus gaining the supreme satisfaction of having appreciated our responsibilities and borne them in such manner as to receive, at last, our own approval.

BURTON EDWARD LIVINGSTON

THE JOHNS HOPKINS UNIVERSITY

INDUSTRIAL RESEARCH IN ONTARIO AND PRUSSIA COMPARED

Those who treat lightly the industrial research of this continent and lavish overdue praise on the research of Germany do not use a standard of measurement—a unit of population in the present case—for the comparison, which through the omission becomes a mere arbitrary opinion. A common example of this laxity is the remark of one who was speaking of the United States and Canada: "Progress along advanced industrial lines has not hitherto paralleled that of Germany." Scrutiny of the statements of such writers on industrial research always fails to show any trace of a standard used in their comparisons, and it is with a view to supply what they omit that the following particulars are compiled:

In 1909 the Ontario government commissioned Dr. John Seath to report upon industrial education, and the report he submitted ("Education for Industrial Purposes"), bearing date 1911, contains some of the latest statistics on technical education before the war, and also contains incidentally some information on the allied subject of industrial research. In particular, he gives a list (p. 161) of the thirty-three technical "schools" of university rank in Prussia which are in a position to undertake research work. This list for Prussia has more details than the similar list in the "Encyclopædia Britannica" (1910–11), which relates to the whole of Germany. The Prussian list consists of the following: nine technical schools, or polytechnica, of which the one at Charlottenburg is the chief example; three mining academies; five forest academies; four agricultural academies; five veterinary "high schools"; five commercial "high schools"; two schools of art.

Junior industrial schools and technical schools of the middle class, the former with state contributions of 38 per cent., the latter with 54 per cent., were educational, not research institutions, and did little work in research, compared with those of university rank given above. If, therefore, we add to this list of 33, the nine medical schools, which are connected with universities in Prussia, and which are doing the public laboratory work—omitting the literary faculties of law, divinity and philosophy in the universities, which are negligible in an enquiry relating to science—we get a complete census of the 42 Prussian institutions that do advanced research work. On a basis of population of 42 millions then in Prussia, we find one such institution for every million people.

Next, consider the case of Ontario, where, as in Prussia, such institutions are mainly provincial or state, and not federal. Following the same order, Ontario has: two schools of applied science and engineering ("polytechnica"); two mining schools doing assay work for the mining industries; one forestry school; one agricultural college at Guelph, doing research for the past forty years (the Ottawa college being federal). The bulletins and reports from Guelph have numbered several thousands. One veterinary college, established in 1862 as a private enterprise when there were very few on this continent, and taken over by the government of Ontario in 1908. Three laboratories, the central at Toronto, with branches at Kingston and London, Ontario, viz., one at each medical college, doing public analysis like those of the Prussian medical colleges. (The federal laboratory at Ottawa deals with adulterations.) One meteorological research observatory for industries, and especially for agriculture and the shipping industries. It is now supported by federal funds but was originally a local institution in Toronto. (The agricultural academies attend to this line of research in Prussia, the meteorological institute in Berlin being mainly a collecting point.)

This aggregate of eleven government institutions of research for the industries of Ontario, on the basis of two and three quarter millions of population at the outbreak of the war, makes a total of four per million people, or four times the number in Prussia for the same unit of population (one million). In making this comparison where the number of institutions of research for the industries is the criterion, there is no separation of research for specific problems from research for

the general benefit of industries, as the two are so closely associated.

Comparisons of data on the numbers of officials and instructors employed, students trained (where it is a teaching institution), and public money expended, when referred to a population basis, would reveal for Ontario, if space warranted their publication, similar favorable results. And it would be easy to cite other provinces and states on this continent comparing favorably with Prussia.

It is not difficult to understand why the faith in German and Prussian "greatness" in research has become so general in America, as it was the privilege of the Germans themselves, as usual, to bell the cat. In November, 1915, a debate took place in the Reichstag over the spending of 40,000,000 marks in propagandist work in the United States of America, and a socialist member asked what good they had received from it. The outlay involved liberal sums for illustrated articles on the industrial training institutions of Germany, inserted in United States illustrated journals which circulate also in Canada. While the propagandists knew the value of advertising, many who read the articles and still derive their arguments from them failed to understand that it was advertising matter. Whatever progress Germany made was due to the application of science to the industries, and no right-minded person would begrudge them peaceable success, if their international politics had been just.

It is not surprising to find that research had been along different lines in Prussia and in Ontario, their material being received here in exchange mostly for well-developed agricultural products. The war changed this, and in a propaganda of the manufacturing classes to throw the burden of research upon the public, paid for out of the public treasuries, it is well to bear in mind the reasonable plan adopted in England of granting a pound of government aid for every pound expended by private enterprise.

A. F. HUNTER

NORMAL SCHOOL BUILDING,
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SCIENTIFIC EVENTS

THE LONDON IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

WE learn from the London *Times* that past and present students of the Imperial College of Science and Technology at a mass meeting in the Imperial College Union, on January 29, decided, with only one dissentient, to sign a petition urging the governors of the college to take immediate steps to raise the status of the college to that of a university of technology, distinct from the University of London, and empowered to confer its own degrees in science and technology.

The petition expressed the opinion that the recognition of the Imperial College as an institution of university rank should be one of the earliest items in the program of legislative reconstruction, and that his majesty's government should give every encouragement to students who desire to devote their lives to science and technology.

Mr. Herbert Wright, one of the governors of the college and a past student, who presided, said they were concerned with the future of the students and the future status of the Imperial College of Science—matters of supreme importance not merely to themselves and those who would succeed them, but indirectly to the whole of the British Empire. The legitimate demand of the day, especially prominent in the City of London, was that there should be established a very close relationship between scientific research and industry. Furthermore, many of them held the view that no honor was too great, no distinction too high, for students who, by the application of scientific principles to the problems of daily life, increased the wealth and power of the British Empire, and added to the grand total of this world's happiness. Industrial concerns in London were strongly in favor of giving full encouragement and the highest recognition to men and women who devoted their lives to scientific and industrial research. They could rest assured that this college had been, and was still, the principal source of supply of technologists to those in charge of industry in the City of London.

Mr H. Burnie, chairman of the organizing Committee, reported that the Royal School of Mines Old Students' Association had passed a resolution giving support to the proposal. The chairman then formally moved that the petition be signed and forwarded to the governors of the college. Captain E. G. Lawford, in seconding the resolution, declared that the time had come when it was absolutely impossible for the Imperial College to carry on exactly as it was now. The reconstruction of London University had been approved, and would be undertaken very shortly; and in that reconstruction the Imperial College was bound to become involved. This would be disastrous to the college. The Imperial College was now standing on the brink of an upheaval, and unless a very strong line was taken it was bound to lose its own identity. By absorption, the college would lose control of its own funds—and of its syllabus, and of its identity as the Imperial College.

CLASSIFICATION OF LANDS BY THE GEOLOGICAL SURVEY

Secretary Lane reports that definite progress was made in the month of January, 1919, in the classification of lands effected by the Geological Survey of the Interior Department. The principal action affecting mineral lands was the restoration of somewhat more than 773,000 acres in North Dakota. These lands lie in the lignite area of that state and the government still owns coal in only a relatively small proportion of those restored. As to this proportion, the restoration will permit the purchase of these lands or of the coal within them at prices of $10 and $20 per acre.

A portion of the results of last summer's field work in the examination of the question of irrigability of western lands appears in orders approved during January which designated somewhat more than 1,000,000 acres for entry under the so-called enlarged-homestead act, the principal requirement under this act being that the lands shall be nonirrigable. The areas designated by states appear in the following table:

	Acres
Idaho	10,840
Montana	17,876
Oregon	39,720
South Dakota	211,331
Wyoming	726,131
Total	1,005,898

Similar progress was manifested during January in rendering lands available for entry in tracts of 640 acres each under the stock-raising homestead law. Somewhat more than 940,000 acres were designated during the month under this act. These lands are distributed as indicated in the table below:

	Acres
Arizona	47,020
California	97,332
Colorado	91,097
Kansas	17,100
New Mexico	392,320
Oklahoma	4,998
Oregon	57,500
Wyoming	234,050
Total	941,417

The total area thus far designated by the secretary for entry under the stockraising homestead act is now a little more than 13,500,000 acres. This work has been accomplished in the slightly more than 19 months since Congress first made provision for the administration of the stock-raising homestead act. After that provision was made, the force for the classifications had to be organized, the principles of classification determined, the lands examined, decisions reached as to their character, and the orders of designation issued.

CIVIL SERVICE EXAMINATIONS

The United States Civil Service Commission announces open competitive examinations for scientific positions as follows:

Department of the Interior: Geological Survey: Geologic aid, March 12–13, $90 a month to $1,440 a year; assistant geologist, March 12–13, $1,500 to $1,800 a year. Indian Service: Oil and gas inspector, March 25, $1,500 to $1,800 a year. Public Health Service; Statistical clerk, March 26, $1,000 to $1,800 a year. Patent Office: Assistant ex-

aminer, March 26–28, May 21–23, July 23–25, $1,500 a year.

Department of Agriculture: Assistant horticulturist, March 18, $1,800 to $2,200 a year; superintendent of road construction, March 25, $150 to $250 a month; assistant dairy husbandman, March 26, $1,500 to $1,740 a year; scientific assistant, April 22–23, $900 to $1,800 a year; United States Game Warden, May 7, $1,500 a year; physical laboratory helper, March 12, April 9, May 7, and June 4, $600 to $900 a year.

Department of Commerce: Physical laboratory helper, March 12, April 9, May 7, and June 4, $600 to $900 a year; Bureau of Fisheries: Apprentice fish culturist, March 12, April 9, May 7, and June 4, $600 to $960 a year. Coast and Geodetic Survey: Marine engineer, April 1, $100 to $140 a month.

Interdepartmental Social Hygiene Board: Supervisor, social hygiene (open to women only), March 25, $2,000 to $2,500 a year; assistant special agent, social hygiene (open to women only), March 25, $600 to $1,000 a year.

National Advisory Committee for Aeronautics: Chief physicist, qualified in aeronautics, March 25, $3,000 a year; physicist, March 25, $2,100 a year.

Full information and application blanks may be obtained by addressing the United States Civil Service Commission at Washington, D. C., or the civil-service district secretary at Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle, or San Francisco.

THE COMMITTEE ON GRANTS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Committee on Grants was appointed by the council of the association to distribute the annual appropriation for research. It is intended that encouragement and support be given to investigations in any of the fields covered by the activities of the association. For the current year the sum of $4,000 has already been assigned, and will be available on April 1. Preference will be given to applications in which definite statement is made of the nature of the problem, the main item of expense, and the probable time for completion of the research. Recipients of grants are expected to agree to the following conditions:

1. The work as outlined will be begun in the near future and efforts will be made to complete it at as early a date as possible.

2. A report will be made to the secretary of the committee on the completion and publication of the work, and in December of each year until the work is completed. The reports will include a financial statement with vouchers for the larger items.

3. In the publication of the results the grant from the Research Fund of the American Association for the Advancement of Science will be acknowledged.

The membership of the committee for the year 1919 is: Henry Crew, chairman; N. L. Britton, W. B. Cannon, J. McK. Cattell, R. T. Chamberlin, L. I. Dublin, G. N. Lewis, G. H. Parker, Joel Stebbins, secretary.

All applications for grants should be received not later than March 15 by the secretary of the committee, who will see that they are properly considered.

Joel Stebbins,
Secretary
University of Illinois Observatory,
Urbana, Ill.

SCIENTIFIC NOTES AND NEWS

Professor Edward L. Nichols, who will reach the age of sixty-five, on September 14, has tendered his resignation of the professorship of physics, at Cornell University, which he has held since 1887.

The Paris Academy of Sciences has elected Major General Sir David Bruce, F.R.S., to be a foreign correspondent in the section of medicine and surgery.

Colonel Victor C. Vaughan, dean of the medical school, of the University of Michigan, will return to the university and resume his duties for the second semester. Colonel Vaughan has been in Washington since the entrance of the United States into the war,

serving with the Medical Corps of the U. S. Army.

Dr. P. W. Bridgman has returned from the naval experimental station at New London, Connecticut, to his work in the Jefferson Physical Laboratory, Harvard University.

Dr. Edgar Buckingham, who has been associated with the work of the scientific attaché of the American Embassy in Rome, has returned to Washington.

Professor Moses Gomberg, of the department of chemistry of the University of Michigan, who has been serving in the Ordnance Department since early in the war, has returned to the university to assume his former work. Professor Gomberg, while in the service, held the rank of major.

Dr. George H. A. Clowes, formerly of the Gratwick Research Laboratory at Buffalo, N. Y., and lately engaged in research at the American University Experiment Station of the Chemical Warfare Service on the physiological effects of war gases, left Washington in January to take up biochemical research at the laboratories of Eli Lilly & Company, of Indianapolis, Indiana.

Dr. Asher F. Shupp has resigned his position as research chemist on dyestuffs for E. I. duPont de Nemours and Company, and is now working on an industrial fellowship at the Mellon Institute.

Mr. Seth S. Walker, formerly associate chemist of the Florida Agricultural Experiment Station and more recently chemist to the Florida Fruit Products Company, has been appointed soil chemist for the Louisiana Agricultural Experiment Station at Baton Rouge.

Henry Allen Gleason, associate professor of botany and director of the botanical gardens at the University of Michigan, has accepted a position as first assistant in the New York Botanical Gardens.

Professor W. W. Rowlee, of Cornell University, has returned to Ithaca after an absence of several months in Central America. There, as a specialist in timber, he was investigating the growth and availability of certain woods of possible use in airplanes and other implements of war.

Dr. William H. Nichols, president of the American Chemical Society, has announced the appointment of the committee to estimate the cost and outline policies for the proposed National Institute of Drug Research to which reference has already been made in Science. The committee consists of Dr. John J. Abel, the Johns Hopkins University; Dr. Raymond F. Bacon, director of the Mellon Institute for Industrial Research; Dr. Frank R. Eldred, research chemist; Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry, chairman;* Dr. Reid Hunt, Harvard University, Dr. Treat B. Johnson, Yale University; Dr. P. A. Levene, Rockefeller Institute, and F. O. Taylor, chairman of the Pharmaceutical Division, American Chemical Society.

Appointment of a committee to study government records of the influenza epidemic has been announced by the Bureau of the Census. Dr. William H. Davis is chairman, the members including C. S. Sloane, representing the Bureau of Census; Dr. Wade H. Frost and Edgar Sydenstricker, of the Public Health Service; Colonel D. C. Howard, Colonel F. F. Russell, and Lieutenant-Colonel A. G. Love, United States Army; Lieutenant-Commander J. R. Phelps and Surgeon Carroll Fox, United States Navy.

There was organized at Washington, D. C., on February 14, an association to be known as the Agricultural History Society. The officers of the society are: Dr. Rodney H. True, Bureau of Plant Industry, Washington, D. C., *president;* Professor Wm. J. Trimble, Agricultural College, N. Dak., *vice-president;* Lyman Carrier, Bureau of Plant Industry, Washington, D. C., *secretary-treasurer;* Professor R. W. Kelsey, Haverford, Penna., and O. C. Stine, Office of Farm Management, Washington, D. C., *members of the executive committee.* The object of the society is "to stimulate interest, promote study and facilitate publication of researches in agricultural history." Any one interested in this subject, who pays

the dues of $1.00 per year, is eligible for membership and should write to the secretary-treasurer.

WE learn from *Nature* that a course of six public lectures on "Physiology and National Needs," arranged in conjunction with the Imperial Studies Committee of the University of London, is being delivered at King's College, Strand, W. C. The first lecture was by Professor W. D. Halliburton on February 5 on "Physiology and the Food Problem," and succeeding lecturers will be Dr. M. S. Pembrey, Professor F. G. Hopkins, Professor A. Harden, Professor D. Noel Paton, and Professor A. Dendy. On February 4, Professor J. T. MacGregor-Morris delivered the first of a course of two lectures at the Royal Institution on "Study of Electric Arcs and their Applications." On February 6, Dr. W. Wilson gave the first of two lectures on the movements of the sun, earth, and moon, illustrated by a new astronomical model. The Friday evening discourse on February 7 was delivered by Professor J. G. Adami on medical research in its relationship to the war; and on February 14 by Professor Cargill G. Knott on earthquake waves and the interior of the earth.

THE Hunterian Oration was delivered before the Royal College of Surgeons of England, on February 14, by Major General Sir Anthony A. Bowlby.

DR. JOHN WALLACE BAIRD, professor of experimental psychology in Clark University, last year president of the American Psychological Association, died on February 2, at the age of forty-five years.

CAPTAIN THEODORE DE BOOY, the archeologist and explorer, died at his home in Yonkers, on February 18. Captain de Booy was born in Holland, thirty-six years ago, and came to the United States in 1906. He was in charge of the West Indian archeological work of the Museum of the American Indian in New York City.

MR. M. N. STRAUGHN, formerly of the Bureau of Chemistry in Washington, died in Porto Rico on January 9, 1919.

THE death of Sir James Sawyer, formerly professor of pathology and medicine at Birmingham, on January 27, in his seventy-fifth year, is announced.

FIGURES are printed to the effect that the 1,200 casualty lists published by the German army and navy contained the names of 1,158 physicians reported slightly wounded, 332 severely wounded, 663 killed, 422 as succumbing to disease, 212 taken prisoner, seventy-two missing and one killed by gas.

THE U. S. Civil Service Commission announces for March 12, an examination for observer and meteorologists, for men only. Vacancies occurring in the Weather Bureau, Department of Agriculture, for duty in Washington, D. C., or in the field, at entrance salaries ranging from $1,260 to $1,800 a year, will be filled from this examination.

THE Grasselli Chemical Company, of Cleveland, Ohio, has announced its intention to found a medal to be awarded annually by the New York Section of the Society of Chemical Industry for the thesis presented before the section which shall, in the opinion of the medal committee, offer the most useful suggestions in applied chemistry.

PROFESSOR J. ROTGANS, of Amsterdam, was given a sum of money, collected by subscription, on the recent twenty-fifth anniversary of his entering on the practise of medicine. He has donated this sum as a nucleus of a fund for cancer research in the Netherlands.

THE sum of £3,000 has been given by Mr. G. T. Hawkins, of Northampton, towards the building and equipment of a pathological laboratory at the Northampton General Hospital.

THE Goodrich conservation bill, which has been the center of controversy in two sessions of the Illinois legislature, has been reported favorably out of committee in the house. The bill calls for a bi-partisan commission of four to take over the work of the state geologist, state entomologist, fish and game commission, state board of forestry, and state park board. It also provides for a director who

shall have supervision of the work of conservation. The house amended the bill by authorizing the Illinois Academy of Science to suggest candidates for membership on the board.

The Bellevue Hospital unit, numbering three hundred physicians, nurses and enlisted men, attached to Base Hospital No. 1, at Vichy, near Paris, has received orders to prepare to sail and probably will return at once. Major John H. Wyckoff, secretary of the medical faculty of the New York University and Bellevue Hospital Medical College, who was formerly one of the heads of the American hospital, has received a letter from Lieutenant Colonel Arthur M. Wright, commander of the hospital, in which he said his organization had been relieved and that the hospital had been taken over by an evacuation hospital personnel. The unit is composed of many well-known New York physicians and nurses from Bellevue Hospital and 200 enlisted men who were recruited at the Medical College for overseas duty. It set sail for France on February 18, 1918, and has since handled a large number of the American Army wounded cases. Base Hospital No. 1 was one of the largest near Paris and received mostly American cases. The organization was prepared for 500 patients but at one time cared for as many as 3,200 cases. The unit includes twenty-six physicians, sixty-five nurses and 200 enlisted men.

UNIVERSITY AND EDUCATIONAL NEWS

At the commemoration day exercises of the Johns Hopkins University on February 22, Dr. William H. Welch, who presided, announced that a sum of approximately $400,000 had been given anonymously for the erection of a building at the Johns Hopkins Hospital to serve as a woman's clinic.

The present applied science building of the University of Toronto, which has been condemned, will be removed and in its place will be erected a large engineering building. The chemistry and mining buildings will be enlarged and will accommodate the department of electrical engineering and applied mechanics.

The farmers of New Jersey, through their representatives at the annual state agricultural convention at the State Capitol at Trenton, have requested the Legislature to provide an appropriation for a horticultural building at the State College of Agriculture at New Brunswick.

The gift to the University of Caifornia Museum of valuable textiles left by the E. E. Caswell Estate and presented to the university through Regent Phoebe A. Hearst, was acknowledged by the board of regents at the recent monthly meeting in San Francisco. The textiles have been loaned to the Palace of Fine Arts for exhibition.

In the reorganization on the basis of departments at Yale University, Professor B. B. Boltwood has been elected chairman of the university department of chemistry.

Professor Guy West Wilson has been appointed associate botanist and plant pathologist in Clemson College, South Carolina.

From *Nature* we learn that Dr. R. M. Cavan, of the chemistry department of University College, Nottingham, has been appointed principal of the Technical College, Darlington, and Mr. W. H. Watson, of the chemistry department of the Northern Polytechnic Institute, has been appointed vice-principal and head of the chemistry and natural science department of the Municipal College, Portsmouth.

DISCUSSION AND CORRESPONDENCE

ELECTRO-THERMO-REGULATOR FOR WATER BATHS

I have read with interest an article entitled "Electro-Thermo-Regulator for Water Baths," by Mr. Charles H. Otis, of the Western Reserve University, which appeared in Science, of October 25, 1918.

Thermostatic control of temperatures for various scientific and technical purposes has become increasingly important in recent years, and we have, therefore, developed an extremely sensitive bi-metallic metal of homogeneous form adapted to such applications.

This metal has already been applied in a number of cases to commercial devices for this purpose, one of which is being manufactured at the present time by the Central Scientific Company.

Any increase of sensitiveness, or any reasonable amount of force on a given temperature change may be obtained by manipulation of the length, width and thickness of the metal. By using very thin sections extreme sensitivity may be obtained, deflections as great as one fourth inch per degree Centigrade being possible. On the other hand, by materially increasing the thickness great force can be created, in one instance approximately one fourth pound per degree Centigrade.

On account of the process of manufacture employed, the danger of permanent set has been practically eliminated, so long as the metal is not overstrained.

G. E. Thermostatic Metal, as it is known to the trade, is produced regularly in thicknesses from .015 to .25 inch; widths up to 6 inches and lengths up to 36 inches. In special cases it may be obtained in thickness as small as .005.

I feel sure that a knowledge of the characteristics and adaptability of this material will enable many experimenters to solve problems of temperature control or indication with much greater ease and accuracy than heretofore.

Chester I. Hall

General Electric Company,
Fort Wayne, Ind.

COMMON NUMERALS

The origin of our common number symbols has never been clearly established, but until recently all writers on this subject agreed that these symbols were transmitted to Europe by the Arabs who had obtained them from India. This is the view expressed in the general encyclopedias and in our mathematical histories which consider this question. For example, in the eleventh edition of the *Britannica* under the word "numeral" there appears the following statement:

The areas designated by states appear in the following table:

> What is quite certain is that our present decimal system, in its complete form, with the zero which enables us to do without the ruled columns of the abacus, is of Indian origin. From the Indians it passed to the Arabians, probably along with the astronomical tables brought to Bagdad by an Indian ambassador in 773 A.D.

In view of these facts it is very interesting to note that during recent years available data relating to the origin of our common number symbols have been carefuly reexamined by Carra de Vaux, who published in volume 21 of *Scientia* a brief summary of his results. Among the most surprising of these results are the following: Our common number symbols originated in Europe and from there were transmitted to the Persians. Both India and Arabia received them from Persia, so that the common term *Hindu-Arabic numerals* is decidedly misleading. The common numerals did not come from letters of the alphabet, but were formed directly for the purpose of representing numbers.

It does not appear likely that all of these conclusions reached by Carra de Vaux, who has made an extensive study of the intellectual life among the Mohammedans, will be at once accepted, but they tend to exhibit the weak foundation upon which the history of our common numerals has thus far rested. In fact, the nature of this question is such that it seems likely that general agreement as regards the origin of our numerals can result only from that attitude of mind (known as philosophy) which would rather accept as facts what can not be proved than acknowledge ignorance. Conclusions similar to those of Carra de Vaux were also expressed in a Russian work by N. Bubnow (1908), which was translated into German and published in Berlin in 1914.

G. A. Miller

PSYCHOLOGICAL RESEARCH FOR AVIATORS

To the Editor of Science: In his article on "Psychological Research for Aviators" in Science of January 24 Dr. Dunlap inadvertently neglects some of the most important

work on tests of flying ability. Burtt, Troland and Miles were working at Cambridge in the spring and summer of 1917, and the work of Captain Henmon at Kelly Field No. 2 in the spring of 1918 was contemporaneous with and under the same authorization as that of Professor Stratton. A prophesy based upon Captain Henmon's results was of notable influence in leading the director of military aeronautics to authorize tests of ability to learn to fly in connection with the regular work of the examining boards.

E. L. Thorndike

Teachers College,
Columbia University

To the Editor of Science: Professor Thorndike has called my attention to the fact that in my article on psychological research for aviators in Science of January 24, I made no reference to the work of Burtt, Troland and Miles, and the work of Henmon, which was reported in relatively full detail in Thorndike's article in the preceding (January 17) number of Science. A footnote referring to Thorndike's report should have been inserted in my article to prevent the supposition that I was covering the work of all investigators. No detailed information concerning the work of Burtt, Troland and Miles was given me until Thorndike's address appeared, hence I should not attempt to describe it. The work started by Stratton, and subsequently developed by Stratton and Henmon, should, as I stated in my article, be reported by Stratton.

I may add that important work in aviation was done by a number of psychologists not mentioned by either Thorndike or myself: Maxfield for instance conducted a valuable piece of research which was, I believe, reported to the psychology committee.

I trust it will be understood that my report was not intended as a comprehensive account of all work in aviation by psychologists, and that if I am able, later, to give a full account of all work done under my control, I shall not attempt to relate the activities of other psychologists except in so far as those activities had direct effects in facilitating or interfering with my own work.

Knight Dunlap

QUOTATIONS

THE HISTORY OF INFLUENZA

Although the term influenza was not formally adopted by the Royal College of Physicians of London till 1782, the disease was known to Hippocrates and other ancient physicians, and a formidable list of epidemics in various parts of the world between the years 1173 and 1875 is given by Hirsch in his "Handbook of Geographical and Historical Pathology." Records of outbreaks in this country between 1510 and 1837 were collected by Theophilus Thompson and published by the Sydenham Society in 1852; they were brought down to 1891 by E. Symes Thompson. Many physicians, among them such men as Sydenham (1675), Huxham of Plymouth (1729), Arbuthnot (1732), Sir George Baker (1762), and John Fothergill (1775) had written about the disease from the clinical point of view, but Immanuel Kant, who, like Bacon, took all learning for his province and was specially interested in medicine, was one of the first to direct attention to its epidemiology. Towards the end of the eighteenth century influenza swept over nearly the whole world. It reached Siberia and Russia, China and India, in the autumn of 1781, and in the following December and February it invaded successively Finland, Germany, Denmark, Sweden, England, Scotland, the Netherlands, France, Italy, and Spain. Kant, in a "Notice to Physicians" published in the lay press of Königsberg on April 18, 1782, considered the disease in its relation to physical geography. He expressed the opinion that it was spread not only by atmospheric conditions but by infection conveyed by insects. The paths of communication between Europe and other parts of the world by sea and by caravan were, he thought, the means of conveyance of many diseases, and he found reason to believe that the Russian trade route to China by land had brought several kinds of harmful insects from the farthest East. The epidemic of 1781–82 spread along the Baltic coast till it reached Königsberg; thence it travelled to Danzig and Prussia. Kant's interest in influenza is shown

by the frequency with which he refers to the subject. With the object of procuring further information he sent his "notice" to Russia, and from Baron von Asch, surgeon in the Russian army, he learned that in January, February, and March, 1782, a disease described as "febris catarrhalis epidemica benigna" prevailed in the Russian capital. It originated in eastern Siberia, on the Chinese frontier, and spread through the whole of Russia. —*The British Medical Journal.*

SCIENTIFIC BOOKS

A Text-book of Precious Stones. By Frank B. Wade, B.S. Published by G. P. Putnam's Sons, 1918. 8vo, pp. xiii + 318. Illustrated.

Those who are familiar with the work on "Diamonds" by the same author will find the present book characterized by similarly attractive features. The style is clear and precise and readability and practicality are afforded by examples drawn from the writer's own experience.

The book will appeal to the amateur rather than the professional student, but this is probably the intention of the author. His experience as a teacher has doubtless aided him in presenting the subject in a systematic and easily assimilable manner. The physical properties of gems are treated under the various subdivisions of refraction, absorption and dichroism, specific gravity, luster, hardness, and color, each to the extent of one or more chapters, and numerous practical details are given in the chapters on testing, cutting, occurrence and imitation of gems. The chapter on "tariff laws" affords useful information not readily found elsewhere and the bibliography of the subject of gems is the most complete and satisfactory for the purposes of the general reader that the reviewer remembers to have seen. The book is not extensively illustrated, a few text figures from line drawings comprising all the pictures that are provided.

Besides its usefulness for general reading, the title of the book and its systematic plan suggest that it could be employed for more formal instruction. The wide distribution of gems in Nature and their possession in some form in almost every home, make it probable that they could be used more extensively than is now the case as a basis for school study.

The reviewer finds little to criticize adversely in the book beyond the occasional use of the term "gemology." While this term might be generally understood to refer to the science of of gems, it is incorrectly formed for this purpose and in reality has quite a different meaning. The Greeks seem to have had no single term for distinguishing objects used for the purposes for which we use gems, but indicated things of value by the adjective τίνιος. Prefixing this adjective to λίθος, stone, the term *tiniolithology* can be obtained, which is at least a word properly formed to indicate the science of gems.

Oliver C. Farrington
Field Museum of Natural History

SPECIAL ARTICLES

PINK ROOT OF ONIONS

In 1915 Professor F. W. Mally called the writer's attention to a very serious disease of onions in Webb County, Texas, and locally known as pink root. Investigations were begun on this disease with Professor Mally, who cooperated in the field experiments and offered valuable assistance in many ways. A search in literature showed that there were no records that could be found, where mention was made of this new plant trouble. From conversation with Professor Mally I was told that Professor W. M. Gilbert, of the United States Department of Agriculture, had at one time worked on this disease and also published an account of the same. However, a letter received from Professor Gilbert dated May 15, 1918, says as follows: "So far as I know there are no publications on this disease, as I did not do enough work on it to secure results for publication and have not had the opportunity to study it very recently." The writer was the first to report on this disease in 1917.[1]

[1] Taubenhaus, J. J., "Pink Root, a New Disease of Onions in Texas," Phytopath. 7: 59, 1917 (abstract).

The symptoms of this trouble are very striking. Affected roots turn yellowish, then pink and dry up. The disease is confined to the roots only and not to the bulb. As fast as the old roots are affected new ones are produced, these in turn becoming diseased. In the end, the bulb spends all its energies in producing new roots which in turn become affected, thus failing to attain the commercial standard. Diseased bulbs remain dwarfed and small to the end of the season, although apparently sound in every other way. The average annual loss from this disease in Webb County may be estimated at forty per cent.

Careful investigations in the laboratory of the Texas Experiment Station revealed the fact that the disease was caused by an apparently new pathogenic organism, the name of which is proposed to be *Fusarium malli,* n. sp. Over one thousand plate cultures were made from diseased material and in nearly every case a pure culture of the above organism was obtained. Moreover in planting healthy onion sets in both sterilized sand or soil in which a pure culture of the *Fusarium* fungus was worked in, the disease in each case could readily be reproduced. The symptoms on the artificially infected plants were in every respect identical with those of infected plants naturally found in the field. The checks remained free, proving that *Fusarium malli* Taub. is the cause of pink root.

Numerous laboratory experiments, which were duplicated in the field have yielded results which are briefly summarized as follows:

1. The disease is carried with infected sets.

2. The disease is carried over from year to year in the soil. Short term rotations with other crops than onions on pink root lands do not starve out the pink root fungus.

3. Pink root attacks not only the onions but also the garlic and the shallot. It does not seem to attack any other of the liliaceous plants.

4 Steam sterilizing will kill the fungus in the soil. Formaldehyde at the rate of one pint to twenty gallons of water, per square foot will also rid the soil of the causal organism.

5. Applications of lime will not rid the soil from pink root.

6. In infected soils liberally fertilized, especially where quickly available plant food is applied, together with proper cultural management, the crop can be nursed to produce fairly normal yields. In this case the proper fertilizer merely stimulates the bulbs in producing new roots faster than the disease can destroy them.

7. Fertilizers rich in nitrogen and organic matter are especially valuable for use in soils infected with the pink root.

8. Healthy sets when planted on diseased soils will contract the disease. Likewise, diseased sets planted on healthy soils will also yield diseased bulbs.

Numerous experiments both in the field and in the laboratory are still in progress and as soon as these are completed a bulletin will be published by the Texas Experiment Station giving a full description of the causal organism and results of the experiments.

J. J. TAUBENHAUS

COLLEGE STATION, TEXAS

A CHROMOSOME DIFFERENCE BETWEEN THE SEXES OF SPHÆROCARPOS TEXANUS

THE chromosome group in the cells of the female gametophyte of *Sphærocarpos texanus* is characterized by one large element greater in length and in thickness than any of the other chromosomes in the group. This large element does not appear in the chromosome group of the male gametophyte, but instead there is a small chromosome commonly nearly spherical in form, and unlike anything found in the female. The other chromosomes in the cells of both sexes vary in length. They have the form of rods, usually curved. The chromosome number for each sex seems to be eight. In the cells of the female, seven of the eight are similar respectively to seven of the male. The eighth chromosome of the female (the largest one) seems to correspond to the small chromosome of the male. The condition as to the chromosomes of the gametophytes in

this species is thus similar to that described by Allen[1] for *S. Donnellii.*

Martha A. Schacke
University of Wisconsin

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE —SECTION M—AGRICULTURE

The program of the Baltimore meeting of the Section of Agriculture was considerably interfered with by sickness and absence in Europe on war service. A single session was held on the afternoon of December 27, 1918. The retiring vice-president, Dr. H. J. Waters, was prevented by sickness from attending the meeting and delivering his address, the subject of which as announced was "The Farmers' Gain from the War."

In the absence of the vice-president, Dr. H. P. Armsby, who is with the Interallied Food Commission in Europe, Dr. A. F. Woods presided over the session. This was devoted to the agricultural situation in Europe as viewed by members of the American Agricultural Commission which spent several months in Great Britain, France and Italy in the early fall.

Describing "Some Impressions of the Effect of War on Agriculture in England and France," Dr. W. A. Taylor reviewed the highly successful efforts in England to stimulate production resulting in 1918 in an increased area in cereals of 32 per cent. and in potatoes of 45 per cent. over the ten-year prewar average. This increase was not due to the existence of an actual shortage, for apparently at no time was there less than three months supply of wheat in sight, or to the expectation of large profits on the part of farmers, but rather to apprehension that conditions might grow worse and to the necessity of saving tonnage. The organization through which the increase was accomplished and the measures put in force under the Defense of the Realm Act were effective and often revolutionary. Local production campaigns were in the hands of agricultural executive committees, who were authorized when persuasion failed to take drastic action, even to dispossessing tenants and breaking up and operating idle land at the expense of the owners. Restrictions on the crops to be grown, their sale and use were extensive and far exceeded anything hinted at in this country. A reform of much importance was the putting into operation of a seed control measure similar to that maintained in several of the states in this country, which yielded such beneficial results that it is expected to be permanent. The government also controlled the price of certain seeds, as seed potatoes, and to avoid local shortages purchased nearly a million dollars' worth of seed potatoes for sale to commercial growers and allotment holders.

While tenant farmers profited by good prices and reduced competition, land owners were prevented by law from raising their rents during the war despite increased taxes and other expenses. In consequence the sales of land exceed those for a generation, and include not only large holdings but relatively small farms, mostly land not operated by the owners. Purchasers are mainly of the tenant farmer class, and no marked movement of population from the city to the land was noted. There was much evidence of greatly aroused interest in agricultural research, instruction and extension teaching which is expected to bear fruit in increased facilities.

In sharp contrast to Great Britain, France showed abundant evidence of decreased crop production, as was to be expected. In 1917 the production of cereals fell to 53 per cent. of the pre-war average. A return to nearly 75 per cent. in 1918 was "accomplished through most strenuous and exhausting effort and to a considerable extent at the expense of future crops through the breaking up of the best crop rotation practise."

The reconstruction problems in France were described as complicated, one of the most difficult being the remanning of the land. Of the 250,000 farmers of the devastated region it is estimated that perhaps 100,000 may return to their holdings. Much of the land consists of small parcels, the holdings of an

[1] Allen, C. E., "A Chromosome Difference Correlated with Sex Differences in *Sphærocarpos*, Science, N. S., 46: 466–467, 1917.

owner being more or less scattered, which points to the importance of consolidating these tracts into compact units capable of more economic management. The question of whether the destroyed rural villages should be rebuilt on their old sites rather than to relocate them more advantageously is another matter of considerable importance. A rapidly growing sentiment was noted for the restoration of the devastated region by the invaders, rather than the mere payment of financial indemnity. The French government has already provided a credit of approximately sixty million dollars, from which allowances are being made to farmers who are ready to return to their land. For the most part the restoration of the fields did not impress the commission as being as appalling as might be expected, and was compared with the reclamation of stump land in this country.

Speaking of the Live Stock Conditions in Europe, Mr. George M. Rommel reported that European farmers had been quite successful in maintaining their supplies of breeding animals. Although they have suffered from a shortage of feed and some inroads have been made on certain kinds of stock by the military demands, the number of cows and heifers in Great Britain is fully as large now as before the war, and this is true of cattle generally. The milk supply has been reduced on account of the shortage of concentrated feed, and this has also cut down the number of pigs quite extensively. There was also a small falling off in sheep.

In France there are about two million less cattle than before the war, principally due to invasion. Since the close of 1914 the decline in number of cattle has been less than 2 per cent., the young stock having increased. A similar increase also applies to Italy. Sheep have declined nearly 40 per cent., due largely to labor shortage, and hogs somewhat more due to a lack of concentrated feed. The shortage of milk in France is more serious than in Great Britain. The heavy demand for horses for military purposes has reduced the available number by about a million. The record of the Percheron horses in the British army has excited a good deal of interest among farmers and breeders in England and led to efforts to establish th breed of horses in that country.

Prices of breeding stock were reported as extremely high in both France and England. Breeders are anticipating a good trade after the war and have kept their stocks intact at great expense. Not much demand for live stock from the United States was looked for in the immediate future, although dairy cows may be needed and after the war American horses will doubtless be required in Europe, mainly of the commercial grades.

Mr. E. C. Chilcott, who went to the French colonies at the instance of the French High Commission, was to have described the agricultural conditions found there, especially in Algeria, but was detained by illness.

At the business meeting Dr. A. F. Woods, president of the Maryland Agricultural College, was nominated vice-president, and Dr. J. G. Lipman, director of the New Jersey Experiment Stations, secretary of the section, and these nominations were subsequently confirmed by the general committee of the association. Other officers for the year were elected as follows: Member of the general committee of the association, Mr. George M. Rommel, U. S. Department of Agriculture; member of the council of the association, Dr. A. C. True, U. S. Department of Agriculture; member of the sectional committee (for five years), Professor C. P. Gillette, director of the Colorado Experiment Station.

E. W. Allen,
Secretary

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THE MEASUREMENT AND UTILIZATION OF BRAIN POWER IN THE ARMY[1]

History of Psychological Service.—The psychologists of America, of whom upward of two hundred served in the Army or Navy, have rendered conspicuously important assistance to the government in organizing an efficient fighting machine. Chief among the civilian agencies responsible for the development of this new and unexpectedly significant variety of service are the American Psychological Association and the Psychology Committee of the National Research Council. Nearly a score of committees or subcommittees of these organizations functioned during the military emergency.

Within the Army three principal groups of psychologists appear: one attached to the Office of The Adjutant General of the Army (specifically known as the Committee on Classification of Personnel in the Army), another in the Office of the Surgeon General of the Army (known as the Division of Psychology of the Medical Department), and a third in the Division of Military Aeronautics (the Psychological Section of the Medical Research Board). Although the several tasks of these groups of psychologists differed markedly, the primary purpose of each was the increase of military efficiency through improved placement with respect alike to occupational and mental classifications.

[1] Published with the approval of the Surgeon-General of the Army, from the Section of Psychology, Office of the Surgeon-General, Major Robert M. Yerkes, Chief.

Psychological service was rendered also to the following divisions or departments in addition to those named above: (1) the Morale Branch of the General Staff, (2) the Division of Military Intelligence, (3) the Committee on Education and Special Training of the War Department, and (4) the Chemical Warfare Service.[2]

Early in the emergency it became clear to psychologists in the military service that the fundamental psychological problem of the army is one of placement and that the most important service psychologists could possibly render would be to assist in so assigning every soldier that his mental (as well as physical) ability should be used to advantage. It was assumed by the psychological personnel that intelligence, alertness, the will to win, enthusiasm, faith, courage and leadership are even more important than are physical strength and endurance, and that this fact must be scientifically reckoned with wherever a strong military organization is to be built quickly. Very promptly it became the recognized purpose of army psychologists to assist in winning the war by the scientific utilization of brain power. The achievement of this purpose necessitated the preparation of special methods of mental measurement in order that recruits should be properly classified for elimination or assignment to military training.

The army, at first naturally and wisely skeptical concerning the practical values of psychological service and inclined to anticipate research instead of service, shortly achieved a new point of view and opinion. Skepticism was replaced in some directions gradually, elsewhere rapidly, by faith in the practicability and immediate value of various kinds of psychological work and eagerness for its continuation and extension. In the end the psychological personnel of the army was completely swamped by requests, demands and orders for help. Scores of telegrams and letters from commanding officers testify to their hearty appreciation of efforts towards scientific placement within the army and their desire for the introduction or furtherance of psychological service in various departments or organizations.

Skeptics, of course, still exist and there are inevitable misunderstandings and prejudices, but the data at hand indicate that at least seventy-five per cent. of the officers of the United States Army have been won by actual demonstration of values and first hand acquaintance with psychological service to its hearty support.

It is extremely important to emphasize at the outset that this article deals with only one of the several important lines of psychological military service, that, namely, of the Division of Psychology of the Medical Department.

Purposes of Mental Examining.—As originally conceived, psychological service within the Medical Department was to assist medical officers, and especially neuropsychiatric officers, in discovering and eliminating men who are mentally unfit for military duty. It appeared, prior to actual trial, that reasonably well planned methods of mental measurement should enable psychological examiners to discover mentally inferior recruits as soon as they arrived in camp and to make suitable

[2] For the United States Navy serviceable methods of selecting, placing and training gunners, listeners and lookouts were devised and developed by Lieutenant Commander Raymond Dodge. The methods prepared by Dr. Dodge as well as certain instruments designed by him for naval use have been extensively and profitably used, and the appointment of this psychologist as Lieutenant Commander in the Naval Reserve is at once a fitting recognition of his practical service and an indication of the appreciation of his work by the officers with whom he has been associated.

recommendation concerning them to the medical offcer. It was also believed that psychologists could assist neuro-psychiatrists in the examination of psychotic individuals. The proposed rôle of the psychologist then was that of assistant to the army surgeon: the actual rôle, as a result of demonstration of values, was that of expert in scientific personnel work.

In interesting contrast with the original purpose of mental examining, as stated above, stands the following account of the purposes actually achieved by this service: (1) The assignment of an intelligence rating to every soldier on the basis of systematic examination; (2) the designation and selection of men whose superior intelligence indicates the desirability of advancement or special assignment; (3) the prompt selection and recommendation for development battalions of men who are so inferior mentally as to be unsuitable for regular military training; (4) the provision of measurements of mental ability which shall enable assigning officers to build organizations of uniform mental strength or in accordance with definite specifications concerning intelligence requirements; (5) the selection of men for various types of military duty or for special assignments, as for example, to military training schools, colleges or technical schools; (6) the provision of data for the formation of special training groups within the regiment or battery in order that each man may receive instruction suited to his ability to learn; (7) the early discovery and recommendation for elimination of men whose intelligence is so inferior that they can not be used to advantage in any line of military service.

Although it originally seemed that psychological examining naturally belonged in the Medical Department of the Army and would there prove most useful, it subsequently became evident that this is not true because the service rendered by psychological examiners is only in part medical in its relations and values. In the main its significance relates to placement and its natural affiliation is with military personnel. For practical as well as logical reasons it would doubtless have been wiser had the service of the Division of Psychology been associated from the first with that of the Committee on Classification of Personnel in the Army, so that the psychological as well as occupational, educational and other important data might have been assembled by a single military agency and promptly rendered available for use in connection with the assignment of recruits. Thus also the organization of a special branch of the General Staff or of a Personnel Section of the Adjutant General's Office to deal with varied problems of military personnel might have been hastened and otherwise facilitated and the utilization of brain power as contrasted with man power in the ordinary sense rendered more satisfactory early in the emergency.

Methods of Measuring Intelligence.—The committee of psychologists originally organized to prepare and test methods of psychological examining for the army promptly decided that it would be desirable to examine *all* recruits in order to provide an intelligence rating for every soldier. This decision necessitated the development of methods which could be administered to relatively large groups and in addition the selection of procedures which could be used for the more careful examination of individuals.

Most of the methods which were recommended to the military authorities in the summer of 1917 have since that time been repeatedly revised and improved in the light of results. The procedures finally

adopted and in use throughout the army during the past few months differ radically from those originally recommended. They may be described summarily as follows:

There are four principal systems or stages in the examination. First comes the procedure of segregation, by means of which the original group, which may, if examining rooms permit, include as many as five hundred men, is split into two sub-groups; (*a*) the literates, men who can speak and read English fairly well, and (*b*) the illiterates, men who are relatively unfamiliar with the English language. These two groups must necessarily be treated somewhat differently, therefore the literates are given a group examination known as Alpha, which consists of eight markedly different tests. This examination, although it requires almost no writing on the part of the subject, does demand facility in using written and oral instructions. The illiterate group is given an examination known as Beta, which is in effect Alpha translated into pictorial form. In this examination pantomime and demonstration supplant written and oral instructions.

Each group examination requires approximately fifty minutes. Subjects who fail in Alpha are ordinarily given opportunity to improve their ratings by taking Beta, and subjects who fail in Beta are given individual examination in order that they may be more accurately and justly rated than in the group examination alone.

Any particular individual may have to take one, two or three of these types of examination, thus for example, a man of low grade literacy who happens to get into examination Alpha may also have to take Beta and some form of individual examination.

Examination papers for both Alpha and Beta are scored rapidly by the use of stencils and the resulting rating is promptly reported to the appropriate military authority.

By means of this system of examinations it is possible for an examining staff consisting of four psychologists and a force of scoring clerks to examine as many as one thousand men per day.

Every man examined by one or more of the procedures described is assigned a numerical rating and in addition a letter grade which indicate his general intellectual ability or mental alertness. The numerical rating is used only for statistical purposes, the letter grade for practical military purposes. The latter alone is reported ordinarily to military officers and recorded on the soldier's service record and qualification card.

The letter grades which are in use are defined as follows: A designates very superior intelligence; B, superior intelligence; C +, high average intelligence; C, average intelligence; C —, low average intelligence; D, inferior intelligence; D —, very inferior intelligence. The letter E has been reserved for the designation of men whose mental ability is seemingly inadequate for regular military duty.

Commissioned officers usually possess and obviously should possess A or B intelligence. Many excellent non-commissioned officers possess C or C + intelligence, but in the main this group is composed of men with C + or B ratings. The great body of privates grades C. Men with D or D — intelligence are usually slow to learn and rarely gain promotion. Many of them, especially the D — individuals, can not be used to advantage in a military emergency which demands rapidity of training. The results of army mental testing indicate that the majority of D — and E soldiers are below ten years mental age. A few fall as low as three or four years.

The contrast between A and D— intelligence becomes impressive when it is shown that men of A intelligence have the requisite mental ability to achieve superior records in college or professional school, whereas D— individuals are rarely able to pass beyond the third or fourth grade of an elementary school, however long they may attend.

Reliability of Methods.—The methods of mental examining used in the army have been found to possess reliability as well as practical value which far exceeded the expectations of the men who are responsible for them. Indeed, the success of this particular methodological undertaking is a remarkable demonstration of the "fecundity of aggregation." It is extremely unlikely that any individual working alone would have developed within reasonable time equally valuable methods of group examining. Inasmuch as reliability is of first importance, various measures of the validity of the army mental tests are presented.

The probable error of an Alpha score is about five points. This is approximately one-eighth of the standard deviation of the scores for unselected soldiers. The reliability coefficient of examination Alpha approximates .95. This group examination correlates with other measures of mental ability as follows: (1) With officers' ratings of their men, .50 to .70 for the total Alpha score and .30 to .54 for the separate tests; (2) with Stanford-Binet measures of intelligence, .80 to .90 for the total Alpha score and .31 to .85 for the separate tests; (3) with the Trabue B and C Completion tests combined, .72 for the total score and .39 to .76 for the separate tests; (4) with Examination Beta, .80; (5) with the composite result of Alpha, Beta and Stanford-Binet examinations, .94; (6) in the case of school children results of Alpha examination correlate (*a*) with teachers' ratings .67 to .82, (*b*) with school marks .50 to .60, (*c*) with school grade location of thirteen and fourteen year old children .75 to .91, (*d*) with age of children .83 (for soldiers the correlation of Alpha score with age is practically zero).

The Alpha examination given with double the usual time allowance correlates approximately .97 with the regular time examination.

The following data indicate the reliability of Examination Beta: It correlates with Alpha, .80; with Stanford-Binet, .73; with the composite of Alpha, Beta and Stanford-Binet, .915. The correlation of the separate Beta tests with the Stanford-Binet ranges from .47 to .63 (average .58). Results of Beta given with double time allowance correlate with those obtained with the regular time allowance .95.

For the several forms of individual examination used in the army the principal correlations at present available are as follows:

Results obtained by repetition of Stanford-Binet examination of school children correlate .94 to .97. Results of one half of the scale compared with the other half correlate .94 to .96. An abbreviated form of the Stanford-Binet examination consisting of two tests per year was used extensively in the army. The results of this abbreviated scale correlate .92 with those obtained by use of the complete scale.

For the Point Scale examination the measures of reliability are practically the same as for the Stanford-Binet.

A Performance Scale examination prepared especially for military use consisted of ten tests. Results for the several tests of the scale correlate with Stanford-Binet results, .48 to .78. Five of the ten tests yield a total score which correlates .84 with the Stanford-Binet score. The same

five tests correlate .97 with the results of the entire scale.

Summary of Results.—After preliminary trial in four cantonments psychological examining was extended by the War Department to the entire army, excepting only field and general officers. To supply the requisite personnel, a school for training in military psychology was established in the Medical Officers' Training Camp, Fort Oglethorpe, Georgia. Approximately one hundred officers and more than three hundred enlisted men received training at this school.

The work of mental examining was organized finally in thirty-five army training camps. A grand total of 1,726,000 men had been given psychological examination prior to January 1, 1919. Of this number, about 41,000 were commissioned officers. More than 83,000 of the enlisted men included in the total had been given individual examination in addition to the group examination for literates, for illiterates, or both.

Between April 27 and November 30, 1918, 7,749 (0.5 per cent.) men were reported for discharge by psychological examiners because of mental inferiority. The recommendations for assignment to labor battalions because of low grade intelligence, number 9,871 (0.6 + per cent.). For assignment to development battalions, in order that they might be more carefully observed and given preliminary training to discover, if possible, ways of using them in the army, 9,432 (0.6 + per cent.) men were recommended.

During this same interval there were reported 4,744 men with mental age below seven years; 7,762, between seven and eight years; 14,566, between eight and nine years; 18,581, between nine and ten years. This gives a total of 45,653 men under ten years mental age. It is extremely improbable that many of these individuals were worth what it cost the government to maintain, equip and train them for military service.

The psychological rating of a man was reported promptly to the personnel adjutant and to the company commander. In addition, all low grade cases and men exhibiting peculiarities of behavior were reported also to the medical officer. The mental rating was thus made available for use in connection with rejection or discharge, the assignment of men to organizations and their selection for special tasks. The mental ratings were used in various ways by commanding officers to increase the efficiency of training and to strengthen organizations by improved placement.

It was repeatedly stated and emphasized by psychological examiners that a man's value to the service should not be judged by his intelligence alone, but that instead temperamental characteristics, reliability, ability to lead and to "carry on" under varied conditions should be taken into account. Even after the feasibility of securing a fairly reliable measure of every soldier's intelligence or mental alertness had been demonstrated, it remained uncertain whether these measurements would correlate positively with military value to a sufficient degree to render them useful. Data which have become available during the past year settle this question definitely by indicating a relatively high correlation between officers' judgments of military value and the intelligence rating.

The various figures which follow are presented not as a summary of the results of psychological examining in the army but instead as samples of these results, the chief value of which is to indicate their principal relationship and practical values.

(*To be concluded.*)

RADIUM PRODUCTION

DURING the period of the war, with no carnotite exports, the greatest part of the world's radium supply has been produced in the United States. The following table shows the radium output of the Standard Chemical Company of Pittsburgh, Pa., since 1913, at which time radium was first produced in the United States.

	Radium Element, Grams
1913	2.1
1914	9.6
1915	1.7
1916	5.0
1917	7.0
1918	13.6
	39.0

It is estimated that the total radium production in the United States to 1919 approximates 55 grams of radium element, and this represents, probably, more than half of all the radium produced in the world.

There has been some discussion lately by members of the Bureau of Mines as to the amount of radium that can be produced from the carnotite fields, as well as suggestions that mesothorium, a by-product from monazite, should replace radium in the luminous material which has found extensive use in the war on airplane and ship instrument dials, compasses, and many indicating devices, and which will find extensive use on watches and clocks, etc.

The estimates of Dr. Moore, of the Bureau of Mines, are based on a very inadequate study of the carnotite region made prior to the war and before the fields had been developed to any great extent. The carnotite holdings of the Standard Chemical Company, which are the largest under the control of a single company or individual and comprising about 350 claims, have been carefully studied —in part by systematic diamond drilling—and this work has been the basis for an estimate that at the least 500 grams of radium should be produced from carnotite. This is five times greater than Dr. Moore's estimate.

As regards mesothorium as a radium substitute, there are several points whose importance Dr. Moore and the Bureau of Mines have overlooked or minimized, in their anxiety to conserve radium. Statistics show that before the war considerably less than one thousand tons of monazite was worked up in the United States per annum in the production of thorium nitrate, and it is estimated that about three thousand tons of monazite supply the world's needs for thorium nitrate. Each ton of monazite containing about 5 per cent. of thoria (corresponding to good Brazilian concentrates) will yield about two milligrams of commercial mesothorium, so that per annum there may be expected a world's mesothorium production of about six grams. The cost of producing monazite will always prevent the production of mesothorium except as a by-product. Unlike radium, which has a half-decay period of 1,700 years and can be used in luminous material immediately after refining and for medical purposes after thirty days' aging, mesothorium has a comparatively brief half-decay period of 5.5 years and its economical use in luminous compound is only possible a year or two after refining. For medical purposes, the short life and varying gamma ray activity of mesothorium make this product less desirable than radium. The following table given by McCoy and Cartledge[1] shows the change in gamma-ray activity of pure mesothorium in time, due to the gradual decay of mesothorium I. (the parent product) and the increase and decrease of radiothorium, which produces thorium D with its very penetrating gamma rays.

THE CHANGE OF GAMMA RAY ACTIVITY OF MESOTHORIUM WITH TIME

Time in Years	Ms I	Th D	Total
0	1.000	0.000	1.000
1	0.881	0.489	1.370
2	0.777	0.781	1.558
3	0.685	0.935	1.620
4	0.604	1.000	1.604
5	0.532	1.007	1.538
6	0.469	0.973	1.442
7	0.413	0.921	1.334
8	0.364	0.855	1.219
9	0.321	0.786	1.107
10	0.283	0.715	1.998

[1] *Jour. Am. Chem. Soc.*, XLI., 53, January, 1919.

The figures given under Th D are based upon the amount of radiothorium which accumulates in mesothorium, and it is this product which also measures the alpha-ray activity of mesothorium. It is evident from the figures given under Th D that the alpha-ray activity of pure mesothorium reaches a maximum between the fourth and fifth year after its preparation and, further, that it is less than 50 per cent. "aged" one year after preparation. In spite of the fact that commercial mesothorium owes a proportion—probably 20 per cent.—of its activity to the presence of radium, it follows that it would be uneconomical to use mesothorium in luminous compound until it had aged for a year or two. It seems evident that the small supply available, the varying activity and the necessity for prolonged aging of mesothorium are some of the reasons that make this material less desirable than radium, both for medical purposes and in luminous compound, especially with an assured supply of radium wholly adequate for both requirements.

Charles H. Viol

Pittsburgh, Pa.

STATISTICAL STUDY OF THE INFLUENZA EPIDEMIC

The American Public Health Association, Vital Statistics Section, appointed a Committee on Statistical Study of the Influenza Epidemic on November 20, 1918. Under the auspices of this committee, a meeting of the state and municipal registrars in the eastern states was held at the University of Pennsylvania, Hygiene Laboratory, Philadelphia, Pa., on November 29 and 30, 1918. There were present, also, at this initial conference, several private statisticians interested in the public health statistics of the epidemic and the results to be derived from study of such data. A series of suggestions was made up, mimeographed and sent to statistical and public health workers for criticism. At the meeting of the Vital Statistics Section in Chicago on December 11, the committee submitted a report on its activities and asked for authority to continue further inquiry into a program of statistical study of the epidemic. The section authorized the continuance of the committee and provided that representatives of the United States Bureau of the Census, of the United States Army and Navy, of the United States Public Health Service, of the state and municipal health boards, and the various statistical, sociological, actuarial and economic associations be represented thereon. The committee was specifically authorized to act in an advisory capacity first, to outline the various sources of data, the minimum standards of tabular and registration practises to be observed by the several organizations providing data, and second, to bring in recommendations on the pathometric or mathematical analysis of published epidemic data. The committee was divided into four subcommittees as follows:

Subcommittee A: *Registration and Tabulation Practise of the Federal Departments.* (Wm. H. Davis, M.D., chief statistician, Division of Vital Statistics, Bureau of the Census, *Chairman;* Richard C. Lappin, *Recorder.*)

Subcommittee B: *Registration and Tabulation Practise of the State Departments and Commissions.* (Otto R. Eichel, M.D., director, Division of Vital Statistics, New York State Department of Health, Albany, *Chairman;* Edwin W. Kopf, *Recorder.*)

Subcommittee C: *Registration and Tabulation Practise of Municipal Boards of Health and of Private Public Health Agencies.* Chas. Scott Miller, M.D., Philadelphia Department of Health, Philadelphia, Pa., *Chairman.*)

Subcommittee D: *Pathometry* (mathematical analysis and interpretation) *of the Epidemic.* (Charles C. Grove, Ph.D., Columbia University, *Chairman;* Arne Fisher, F.S.S., *Recorder.*)

Mr. E. W. Kopf was delegated to act as chairman of the General Committee and to coordinate the work of the several subcommittees. The General Committee of the Vital Statistics Section was authorized to cooperate in statistical matters with the Influenza Reference Committee of the entire association.[1]

[1] See "Influenza Bulletin." *American Public Health Association,* Boston, December 13, 1918.

Federal Statistics of the Epidemic.—At the Washington meeting of Subcommittee A, the following subjects were taken up:

Estimates of population.

Obtaining estimates of Army and Navy populations by five-year age periods, through random sampling if necessary, but by direct tabulation of army and navy enlistment records if possible.

Causes of death reported during the epidemic were to be classified in accordance with the Manual of the International List of Causes of Death and the Index of Joint Causes as published by the Bureau of the Census.

Infant mortality was to be studied in such manner as to show what part of this mortality was probably due to birth mortality arising out of influenzal illness of the mother and to the factor of neglect.

Norms of mortality during September, October and November were also considered.

It was also indicated that it was unwise to draw any conclusions from statistics of variations in bacterial flora at various stages in the epidemic or in different localities unless it was shown that all laboratory conditions had been properly controlled. The Army was requested to supply statistics as to influenzal sickness classified by five-year age periods, by date of onset, by duration of illness in days, by principal complications, showing fatality or lethal rates per one hundred completed cases.

State Statistics of the Epidemic.—Subcommittee B considered the more intimate statistics of the epidemic in the states. The subcommittee pointed out that in certain cities and for certain states valuable data were available in the back files which would lead to the determination of the norm of mortality during the fall and winter months of the year. The social statistics of the epidemic were emphasized. It was urged that statistics of the effect of the epidemic upon the family should be collected. State and municipal governments were urged to make preparations necessary for the proper statistical study of the epidemic data.

Municipal Statistics of the Epidemic.—The subcommittee on municipal statistics discussed chiefly the available data in the files of maternity clinics and visiting nursing associations. It was indicated that thorough study of these records would bring out some of the important facts on the obstetrical data of the epidemic.

Mathematical or Pathometric Study of the Epidemic.—The Subcommittee on Pathometry has outlined for itself the problems of mathematically testing and graduating the crude compiled data for norms of infant and adult mortality. The subcommittee has in mind the frequency curves of mortality from the several important causes of death during the fall and winter months of the year, especially the curves for infant mortality considered as (*a*) "birth mortality" and (*b*) "true infantile mortality." By means of modern analytic methods it was aimed to determine the true "excess mortality" during the epidemic. It was planned also to fit various curves to the observed epidemic data, to compute the equations and the constants of the distributions in the several areas under observation (mean, mode, dispersion, skewness, "excess").

The Subcommittee on Pathometry also anticipated that it could determine by delicate mathematical tests the *probable* date of the beginning, "peak" and ending of the several waves or phases of the epidemic in the various communities, and possibly, the approximate differential equations representing the several recurrences or recrudescences of the epidemic could be established.

International Statistics of the Epidemic.—On January 18, 1918 the Executive Board of the Association directed the chairman of the committee on Influenza Epidemic Statistics to initiate correspondence with sanitary institutes and public health associations abroad, with a view toward drafting a program of international study of the epidemic data. The cooperation of the International Statistical Institute will be solicited.

Methods of Influenza Study Applied in Preventive Medicine Generally.—The methods of higher analysis applied to the influenza epidemic data can be of service to preventive medicine in the study of other diseases. The

profession of statistics is confronted with an opportunity for unparalleled service to the medical sciences, among them preventive medicine.

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SCIENTIFIC EVENTS

GEORGE FRANCIS ATKINSON

The faculty of Cornell University has passed the following resolutions on the death of Professor Atkinson:

The University Faculty desires to express its profound sorrow and its sense of great loss through the death, on November 14, of George Francis Atkinson.

Since his return to his alma mater in 1892, he has been a member of this faculty. In 1896 he was appointed professor of botany. During this period of more than a quarter of a century, which was devoted unceasingly and enthusiastically to research, he became an active working member of numerous scientific societies, and attained an eminent position among the botanists of the world. In mycology, particularly, he had an international reputation and he was regarded as the foremost authority on the fleshy fungi of this country. In June, 1917, the board of trustees generously relieved him of all further teaching and administrative duties in order that he might devote his time entirely to his researches in this field. His exceptional ability and high place among American men of science was formally recognized by his election to the National Academy of Sciences, in April, 1918. To his services as a teacher in that higher sense of the word which implies ability to impart enthusiasm and love for research, the success of the large number of botanists throughout the country who have been his pupils bears glowing testimony.

His end came suddenly as the result of influenza followed by pneumonia, incurred during a collecting trip on the Pacific coast in pursuance of the great monographic study of fleshy fungi upon which he had been engaged for many years, and which was nearing completion. In the death of Professor Atkinson not this faculty alone but the whole community of working men of science have lost a gifted colleague; a man of genius who contributed much to the world's knowledge of botany. His work lives after him, not only in his writings but in the inspiration imparted to a younger generation of investigators in the field in which he was an honored master.

MEDICAL RESEARCH IN AUSTRALIA

The *Journal of the American Medical Association* states that the Walter and Eliza Hall Institute of Research in Pathology and Medicine has been established in Melbourne in connection with the Melbourne Hospital, through the generosity of the trustees of the Walter and Eliza Hall Fund. The institute is controlled by a board representing the trustees, the University of Melbourne and the Melbourne Hospital. A spacious building, including a basement and three stories, has been erected at a cost of over \$60,000 in immediate connection with the pathologic department of the hospital. The hospital itself has recently been entirely rebuilt and now contains 350 beds. Applications for the offices of director and of first assistant of the institute are being invited through the agent-general for Victoria, Melbourne Place, Strand, London, from whom full information may be obtained. The director has the management of the institution; devotes his whole time to this work, is responsible for keeping research as the primary object of the institution, will give all assistance to the medical staff and other officers of the Melbourne Hospital in postmortem work and clinical pathology, will make arrangements for clinical instruction and laboratory instruction to medical students in postgraduate work, and provide or maintain the comforts of patients or others residing in, or who use the hospital. His term of service is five years and he is eligible for reappointment. His salary is \$5,000 a year, and in addition, the board will procure an endowment insurance on the director's life, to be payable at the age of sixty or predecease, the annual premium for this insurance being \$375. If the director comes from America, \$625 will be allowed for travel expenses. Ap-

plicants should be between the ages of twenty-five and thirty-five. All applications must be accompanied by original or certified copies of testimonials, schedule of experience, list of research work and photograph. It is expected that the director will take duty, October 1, 1919. The first assistant director shall be not over thirty-five years of age, and will be expected to devote his entire time to the work of the institute as directed by the board and under the instruction of the director. He will have the management of the institution in the absence of the director, will give such assistance as may be prescribed to the medical staff or other officers of the Melbourne Hospital in postmortem work and clinical pathology and bacteriology, and will take such part as may be prescribed in the instruction of medical students in laboratory work and in postgraduate instruction. He holds office for five years and is eligible for reappointment. His salary will be $3,000 a year.

THE BRITISH GUIANA RESEARCH STATION OF THE NEW YORK ZOOLOGICAL SOCIETY

IN his introduction to the volume "Tropical Wild Life in British Guiana" Colonel Theodore Roosevelt said: "The establishment of a Tropical Research Station in British Guiana by the New York Zoological Society marks the beginning of a wholly new type of biological work, capable of literally illimitable expansion. It provides for intensive study, in the open field of the teeming animal life of the tropics."

Almost every member of the staff of this station has been serving in the American army, and now at the conclusion of the war, an expedition is about to start for British Guiana to resume scientific investigation. The financial support necessary for this undertaking has been provided by the New York Zoological Society through the generosity of five members of the board of managers, Col. Anthony R. Kuser, C. Ledyard Blair, Andrew Carnegie, George J. Gould, and A. Barton Hepburn, and the requisite leave of absence has been granted to the staff in the service of the society.

On February 26 three of the staff sailed for the south, William Beebe, director, Alfred Emerson, research assistant, and John Tee-Van, artist and preparateur. Their outfit will include the most complete laboratory equipment ever taken to the tropics, and the station will be reopened under most auspicious circumstances at Katabo, its permanent headquarters. This is a most beautiful site, shaded with hundred foot bamboos, at the very edge of the jungle, and directly at the junction of two great rivers, the Mazaruni and the Cuyuni. Here several bungalows and a large laboratory await occupancy, and here it is hoped that many of our American scientific men may find a stimulating field for the prosecution of their particular lines of research.

While each member of the regular staff will undertake some special investigation, yet it is the intention of the director that all will unite in some definite ecological study of the interrelations of certain groups of organisms, in the hope of gaining some insight into more general problems of evolution, of adaptation, of survival. The results of all the studies will be published by the New York Zoological Society in the second volume of "Tropical Wild Life."

Three years ago Colonel Theodore Roosevelt visited the Station and wrote of its functions and activities. This year Professor Henry Fairfield Osborn, president of the Zoological Society and of the American Museum, accompanies the expedition and will spend several weeks in observing the unique conditions under which the undertaking carried on, and will advise as to its extension and future.

Professor William Morton Wheeler, of the Bussey Institution, Harvard University, and Professor Ulric Dahlgren, of Princeton University, and Professor Alfred Reese, of the University of West Virginia, will join the station this year, for observations on ants, electric fishes and crocodiles, respectively. Director N. L. Britton, of the New York Botanical Garden, is planning a complete survey of the forests.

SCIENTIFIC NOTES AND NEWS

Dr. Livingston Farrand has resigned the presidency of the University of Colorado to become the executive head of the American Red Cross. Dr. Farrand was formerly professor of anthropology at Columbia University.

Professor Albert Sauveur, of the metallurgical department of Harvard University, has returned to Cambridge from France, where he has been engaged in war work during the past year. While stationed in Paris, Professor Sauveur was in charge of the section of metallurgy in the technical division of the United States Air Service.

Dr. Thomas McCutcheon, associate professor of chemistry, at the University of Pennsylvania, has resumed his work there. Dr. McCutcheon has been in the service of the War Industries Board and has been in England and France.

Major George B. Wallace, professor of pharmacology, and Captain C. J. Tyson, instructor in medicine at the University and Bellevue Hospital Medical College of New York University, last week resumed their duties after army service in France. Major Wallace saw long service with Base Hospital No. 1 at Vichy, near Paris. Captain Tyson, at first connected with Base Hospital No. 1, was later made assistant sanitary inspector with the Second U. S. Field Army, with which he saw active service at the front.

Captain P. L. Thorne, assistant professor in mathematics at New York University, resumed his duties with the faculty this week. After entering the service, Captain Thorne served for a time as an artillery instruction officer but later went to the front in France with the Sixtieth Heavy Artillery regiment.

Captain I. F. Eldredge has returned from France and will resume his duties as forest supervisor of the Florida National Forest. Captain Eldredge was associated with the 10th Engineers (Forestry).

Dr. F. L. Wells, having been released from military duty with the Air Service, has returned to his former work at McLean Hospital.

Dr. J. P. Rowe, professor of geology at the State University of Montana, who is on leave of absence for war community service, is now in Los Angeles. His stay is indefinite because the work he is doing will be continued as long as men are at cantonments and naval training stations.

Captain W. D. A. Peaslee, assistant professor of electrical engineering at the Oregon Agricultural College on leave of absence, has been appointed a member of the consulting staff of the American peace conference.

Sergeant H. M. Wight, instructor in zoology at the Oregon Agricultural College on leave of absence, has been awarded the French war cross for heroism on the field of battle.

Sir Richard Threlfall, formerly professor of physics in the University of Sydney, has been elected a member of the Athenæum Club, London, for eminence in science.

Secretary Lane has appointed a commission of five mining and metallurgical experts from the Bureau of Mines and the Geological Survey to visit Europe to observe and assist reconstruction methods in the devastated regions of France and Belgium. The chairman of the commission, Dr. Frederick G. Cottrell, chief metallurgist of the Bureau of Mines, and George S. Rice, chief mining engineer of the bureau, have sailed for France. Frank H. Probert, consulting engineer of the bureau and professor of mining in the University of California, sailed several weeks ago, and R. H. Cameron, consulting chemist of the bureau, and Hoyt S. Gale, of the Geological Survey, are expected to leave early in March.

C. L. Alsberg, chief of the Bureau of Chemistry, U. S. Department of Agriculture; John Howland, professor of pediatrics, Johns Hopkins University Department of Medicine, and Henry Kraemer, professor of pharmacognosy, University of Michigan, college of pharmacy, have been reappointed to serve on the Council on Pharmacy and Chemistry for a further period of five years. W. W. Palmer, associate professor of medicine at the college of physicians and surgeons of Columbia University, has been selected to fill the vacancy caused by

the death of Professor J. H. Long, Northwestern University, who had been a member of the council since its organization.

C. W. HUNGERFORD, assistant plant pathologist at the Oregon Agricultural College, connected with the office of cereal investigations, Washington, D. C., has left for Moscow, Ida., where he has been appointed plant pathologist in the University of Idaho experiment station.

MISS KATHERINE VAN WINKLE, a former student in the University of Washington, Seattle, Wash., is spending the year at Cornell University, where she holds a fellowship in the geological department. She is specially interested in making a comparison of the East and West Coast Eocene Mollusca.

C. M. BAUER, formerly with the U. S. Geological Survey, and Mr. R. W. Clark, formerly of the geological department of the University of Michigan, have opened a consulting office at Okmulgee, Oklahoma.

EDWARD W. BERRY, professor of paleontology, and Joseph T. Singewald, Jr., professor of economic geology, at the Johns Hopkins University, will leave in April to spend six or seven months in geological explorations in the Andes of Peru, Bolivia and Chile, under the George Huntington Williams Memorial fund.

HENRY S. GRAVES, United States forester, spoke on "The Need of Private Forestry," before the Boston Chamber of Commerce on February 24, 1919. This address was part of the program in connection with the forestry conference held at Boston on February 24 and 25 under the auspices of the Massachusetts Forestry Association.

THE Washington Section of the Society of American Foresters, at its meeting on February 26, 1919, had presented to it papers on the "Application of the Principles of Plant Succession in relation to Range Revegetation," by Arthur W. Sampson, and in relation to Forest Regeneration, G. A. Pearson.

THE fifth Harvey Society lecture of the series will be by Colonel F. P. Underhill on "War Gases" at the New York Academy of Medicine on Saturday evening, March 15.

THE annual Darwin Day lecture at New York University, commemorating his birthday, was given on February 12 in the auditorium at University Heights by R. L. Ditmars, curator of reptiles, at the New York Zoological Gardens. His subject was "Life at the Bottom of the Sea," illustrated by four reels of motion pictures of submarine life taken in the bay of Naples. Professor Charles L. Bristol also spoke on the work of Darwin.

A JOINT meeting under the auspices of the New York Section of the American Electrochemical Society with the New York Section of the American Chemical Society and the Society of Chemical Industry was held at Rumford Hall on February 7, when the program was "Electro-chemistry in War Time" by Lieut. Col. Wilder D. Bancroft, C.W.S. U. S., and "War Time Trip to Europe" by H. C. Parmalee.

THE American Institute of Mining Engineers meeting in New York on February 17 held a service in memory of Dr. Rossiter W. Raymond, second president of the institute and secretary emeritus at the time of his recent death.

DR. TIMOTHY MATLACK CHEESMAN, instructor in bacteriology in Columbia University from 1888 to 1899 and later a trustee of the university, died on February 28, at his home at Garrison-on-Hudson, aged sixty-six years.

THE death on February 8 in Philadelphia, from pleurisy and pneumonia, of Dr. Frederic Putnam Gulliver, of Norwich, Conn., is announced. Dr. Gulliver was connected with the chestnut blight commission in Philadelphia for some years, prior to which he was topographer in the United States Geological Survey. For eight years he was master of science at Saint Mark's School in Southborough, Mass. He was secretary of Section E (Geology and Geography) of the American Association for the Advancement of Science from 1907 to 1911.

DR. PAUL CARUS, editor of the *Open Court* and *The Monist*, the author of many philo-

sophical books and articles, died on February 11. He was born in Germany in 1852.

Mr. Alonzo Howard Clark, curator of the division of history of the National Museum, and editor of publications at the Smithsonian Institution, died on December 31, 1918, in his sixty-ninth year.

The death has occurred of Miss Laura Bradstreet White, a teacher in the Girls' High School in Boston from 1872 to 1916, and head of the science department since 1875. She is described by one of her colleagues as a woman of "rare social gifts, a leader among men and women, an authority on chemistry, and a force among teachers as well as those taught."

G. Carey Foster, F.R.S., formerly principal of University College, London, and previously professor of physics there from 1865 to 1898, died on February 9 at the age of eighty-three years.

R. A. E. Blanchard, professor of parasitology in the faculty of medicine, University of Paris, has died aged sixty-two years.

Dr. I. C. L. Holm, leader in the development of the sanatorium system in Norway, has died at the age of seventy three years.

Dr. W. J. Holland, the director of the Carnegie Museum, desires to notify the direction of all museums and all collectors of birds that a shipment of birds made for the Carnegie Museum in French Guiana and in the vicinity of Pará, Brazil, was broken into and robbed of a large part of its contents on its arrival in New York City early in February, and he desires to warn all parties to whom specimens may be offered, coming from these parts and identified as collected by S. M. Klages, that such specimens are stolen goods, and he also requests any one to whom such material may be offered to hold it and to notify him of the name and address of the person offering them, so that the proper steps may be taken for their recovery.

The annual meeting of the American Association of Anatomists which was postponed last December, will be held April 17 to 19 in Pittsburgh. Professor R. R. Bensley, of the University of Chicago, is president of the association and Professor C. R. Stockard, of Cornell University Medical College, is secretary.

The American Association of Petroleum Geologists will hold its fourth annual meeting at Dallas, Texas, on March 13 to 15 next. The headquarters of the Association will be at the Adolphus Hotel. An interesting and attractive program has been arranged. Further details in regard to the meeting can be secured by addressing Mr. W. E. Wrather, 6044 Bryan Parkway, Dallas, Texas.

The Bureau of Economic Geology and Technology of the University of Texas is endeavoring to make a geological map of every county in the state. In the interest of this work E. H. Sellards, geologist in the Division of Economic Geology of the Bureau, recently spent two months in San Antonio making a map of Bexar county.

Dr. R. F. Shields, of the University of Shantung, has recently accomplished the difficult task of translating Lewis and Ströhr's "Histology" into Chinese. An abbreviated edition of Halliburton's "Physiology and Histology" had been previously available to Chinese medical students, but Dr. Shield's book is apparently the first in that language devoted entirely to microscopic anatomy.

The *Publishers' Circular and Booksellers' Record,* as quoted in *Nature,* records a total of 7,716 books as having been published during the year 1918. This is a decrease of 415 compared with the previous year, and it is accounted for chiefly by a falling off in the number of works of fiction (—523) and juvenile literature (—155); other classes that have also decreased slightly are education, agriculture, domestic, business, history and geography. On the other hand, sociology has increased by 112, technology by 110, medicine by 80, and poetry by 98. Under "Science" the number of new books recorded is 232, also 5 translations and 28 pamphlets. In addition, there were 64 new editions, making a total of 329. In the year 1914 science occupied the third place in twelve classes of literature, and technology the fifth place; in 1918 technology

was in the eighth place and science in the tenth.

VOLUME VI. of "Fossil Vertebrates in The American Museum of Natural History" has just appeared from the department of vertebrate paleontology of that institution. It includes contributions 168 to 192, which appeared during the years 1915 to 1917 inclusive, from the studies of Osborn, Matthew, Brown, Granger, Gregory, Mook, Anthony, Watson and von Huene. These articles are collected from the *Museum Bulletin* volumes of the corresponding years. The edition is limited to sixty and is distributed to the principal research centers in this country and abroad.

The American Journal of Orthopedic Surgery, the official publication of the American Orthopedic Association, will become also the organ of the newly-formed British Orthopedic Association under the name of the *Journal of Orthopedic Surgery.* This has been brought about through the increased interest and importance of the subject of orthopedics on account of the war. It is believed the purposes of the orthopedic branch of surgery will be best served by the amalgamation, an idea long cherished by Lieutenant-Colonel Robert B. Osgood, M.C., U. S. Army, Boston, who promoted the establishment of the American journal. The journal will be published from the present offices in Boston. The committees appointed by the British Orthopedic Association consist of R. C. Elmslie, editor, London; T. R. Armour; W. H. Trethowan and H. Platt; while Charles F. Painter, Boston, and Robert W. Lovett, Boston, comprise the committee appointed by the American Orthopedic Association. Miss Hannah Lissner, Boston, has been appointed in charge of the editorial department of the journal in America.

IT is stated in *Nature* that a party of American technical journalists recently on a visit to England as guests of the government was entertained by the Company of Stationers on December 18, together with a gathering of British colleagues. The meeting had been arranged by the Institute of Journalists' Circle of Scientific, Technical and Trade Journalists, after the return of the American party from its tour of France. After tea and a reception a meeting was held, at which Mr. H. C. Parmelee, Mr. S. O. Dunn, Mr. H. Cole Estep, Mr. H. M. Swetland and Mr. A. J. Baldwin delivered short addresses on behalf of the American technical journalists, while Mr. L. Pendred, Professor R. A. Gregory and Mr. A. C. Meyjes responded for the British technical press. Some striking instances of the services rendered in connection with the war and their influence on the industrial development were given, and stress was laid on the value of wide and thorough training, with the view of raising the status of technical journalism as a profession. A resolution was moved by Mr. H. C. Parmelee, seconded by Mr. A. C. Meyjes, and carried unanimously, urging the desirability of closer cooperation and periodical exchange of views between the trade and technical press in the two countries. Mr. L. Gaster, chairman of the circle who presided, voiced the pleasure of the meeting in welcoming the guests, and Mr. A. J. Baldwin expressed the hope that British technical journalists would reciprocate by sending a deputation to the United States in the near future.

WE learn from *Nature* that the annual meeting of the English Geographical Association was held on January 3 and 4. In the afternoon of the former day Mr. A. R. Hinks gave an address on war-maps at the Royal Geographical Society's house. A collection of captured maps and maps made by the Royal Geographical Society were on view; and there was also an exhibition of war maps, lent by the authorities, at the London Day Training College, where the remaining meetings were held. An address was given by the president, Professor Grenville A. J. Cole, on the narrow seas and on the Arctic route to Muscovy. Other subjects brought forward were: The historical geography of West Africa, by Mr. W. H. Barker, and when and how often should we teach the geography of the British Isles to our pupils, a discussion led by Miss D. D. Adam and Mr. C. B. Fawcett.

The American Journal of Physical Anthropology, founded and edited by Dr. Aleš Hrdlička, of the U. S. National Museum, has completed its first volume. The contents apart

from literature received and notes are as follows:

Hrdlička, Aleš: Physical Anthropology: Its Scope and Aims.

Miller, Gerrit S., Jr.: The Piltdown Jaw.

Hooton, Ernest A.: Eskimoid Characters in Icelandic Skulls.

Holmes, William H.: Committee on Anthropology, National Research Council.

Keith, A.: Anthropological Activities in connection with the War in England.

Hrdlička, Aleš: Physical Anthropology: Its History in America.

Williams, E. T.: The Origin of the Chinese.

Guthe, C. E.: Russian Jews in Boston.

Hurlin, Ralph G.: Preparation of Skeletons by Bacterial Digestion.

Hrdlička, Aleš: Physical Anthropology: Recent History and Present Status.

Babcock, Wm. H.: Early Observations in American Physical Anthropology.

Giuffrida-Ruggeri, V.: The Origins of the Italian People.

Schultz, Adolf H.: External Nose, Bony Nose and Nasal Cartilages, in Whites and Negroes.

Lundberg, Emma O.: The Illegitimate Child and War Conditions.

Hrdlička, Aleš: Physical Anthropology: Conclusion.

Boas, Franz: Anthropology of Sweden.

Farabee, Wm. Curtis: The Arawaks of Northern Brazil and Southern British Guiana.

UNIVERSITY AND EDUCATIONAL NEWS

The Carnegie Corporation of New York has voted a grant of $500,000 to the Medical Department of Queen's University, Kingston, Ont. This grant is related to that in the will of Dr. James Douglas, New York, and is conditional or raising an additional $500,000.

The *Journal* of the American Medical Association states that plans have been drawn for a proposed new building on the grounds of the Johns Hopkins Hospital to house the medical library of the hospital and the surgical histories of patients who have been treated there, and will also contain an auditorium, with subsidiary rooms for religious and philanthropic work. The library will be built in honor of Dr. Henry M. Hurd, Baltimore, who for many years was superintendent of the hospital. The structure, according to the present plans, will cost $100,000. Gifts of $50,000 and of $30,000 have been made.

Under the will of the late Mrs. Purdie the residue of her estate, amounting to about £25,000, has been bequeathed to the University of St. Andrews for the promotion of research in chemistry. Her husband, the late Professor Purdie, had built for the university an institute for chemical research.

Dr. H. M. Parshley, of the department of zoology in Smith College, has been promoted to an associate professorship. He has been appointed associate in field zoology at the Cold Spring Harbor summer laboratory.

Dr. Harry N. Eaton, formerly associate professor of geology in the Pennsylvania State College, has been appointed to a similar position in Syracuse University. He spent the past fall and early winter in research in the paleontological laboratory of Dr. G. D. Harris at Cornell University.

Dr. W. E. Milne, recently of Bowdoin College, has accepted the position of professor of mathematics at the University of Oregon.

DISCUSSION AND CORRESPONDENCE

THE KATMAI NATIONAL MONUMENT AND THE VALLEY OF TEN THOUSAND SMOKES

To the Editor of Science: In your issue of January 3 you print a note headed "The Katmai National Monument," derived from the annual report of the director of the National Park Service. In such a report, compiled by men not familiar with the Valley of Ten Thousand Smokes and not students of volcanism, some misconceptions and misinterpretations are very apt to creep in. This was particularly likely in the present instance, since the publication of the technical papers devoted to the scientific results of the expeditions, from which alone the necssary information could have been derived, has been delayed.

The hypothesis that would occur to any one as the most probable explanation of the Valley of Ten Thousand Smokes is that given

in your article. But no scientist would venture categorically to affirm, without investigation, the correctness of such a hypothesis, as is done in your columns when you state that the valley is due to heated rocks which

> turn to instant steam the spring and drainage waters of many a surrounding mile of foothills. Thus originates the steam which bursts forth from the myriad valley vents. The phenomenon is familiar in the neighborhood of most volcanoes which still are classed as active. Steaming springs, a later stage of the vents in this valley, are found upon the flanks of several of the most prominent of our Cascade volcanoes, and are numerous around the base of Lassen Peak.

Now, as a matter of fact, there is no evidence that the vents of the Ten Thousand Smokes have any connection with the vaporization of surface drainage. The writer gives strong reasons for the belief that they are, on the contrary, true volcanoes in an article entitled "Are the Ten Thousand Smokes Real Volcanoes?"[1] There is not space to give the evidence here, but some of the facts which lead to that conclusion may be summarized.

1. The disposition and magnitude of the vents are such as to make them very difficult to explain on the surface water hypothesis.[2]

2. The temperature of all the larger vents in the valley is far above that of ordinary steam. The expedition of 1918 measured many temperatures above 300° C., while the highest was 432° C. Curiously enough the "smoke" from a number of these vents is hotter at the surface of the ground where it meets the cold atmosphere than it is a few feet down the throat. In one case where the temperature is 352° C. at the surface it is only 245° C. three feet down in the throat—a difference of 107° C.[3]

3. The smoke from the vents is by no means all water vapor. It includes many other volcanic gases. Most notable among which is perhaps hydrofluoric acid in such high concentration as to etch the glass on the inside of the vacum tubes which were used for collections. Dr. E. T. Allen, of the Geophysical Laboratory, who has made a preliminary examination of the deposits, has informed me also that the incrustations around the vents are rich in fluorides. The chemical study of the gases, undertaken by Dr. E. S. Shepherd, of the same institution, would probably have been completed by this time if it had not been interrupted by the diversion of chemists to war problems.

4. The Vents of the Ten Thousand Smokes are by no means secondary openings consequent upon the eruption. On the contrary, they are associated with an extraordinary deposit of fragmental material poured out *before* the explosion of Katmai. This deposit is described in detail in the third of the papers giving the scientific results of the expeditions.

There are still very many problems to be worked out in connection with this remarkable district but even now it may be asserted with confidence that the Valley of Ten Thousand Smokes is no secondary phreatic phenomenon but on the contrary is a true manifestation of the forces of volcanism of a character and magnitude unparalleled in the present day world.

ROBERT F. GRIGGS

DIRECTOR KATMAI EXPEDITION,
NATIONAL GEOGRAPHICAL SOCIETY

[1] "Scientific Results of the Katmai Expeditions of the National Geographic Society, II," *Ohio Journal of Science*, December, 1918.

[2] For details see paper cited.

[3] The studies of temperature upon which these statements are based will be given in full in the fifth number of the "Scientific Results of the Expeditions," which is in press.

HEREDITARY DEFICIENCIES IN THE SENSE OF SMELL

IN a recent number of SCIENCE, Professor Glaser[1] has recorded a family history which is supposed to show inheritance of deficiencies in the sense of smell. There are certain modifying conditions, not considered in estimating the history, which should be kept in mind in analyzing this case in particular, as

[1] SCIENCE, N. S., Vol. XLVIII., p. 647, December 27, 1918.

well as the inheritance of various degrees of anosmia in general.

"The case in point is that of a young Russian Jew, a fugitive from Kiev." This individual from Glaser's description presents a definite case of anosmia. He is devoid of powers of olfaction, though possessing a sense of feeling in certain regions of the nasal epithelium due to the presence of normal trigeminal endings.

The family of which he is a member has certain degenerate characteristics, which probably result from diseased conditions, since he is from a region in which syphilis and other diseases are extremely prevalent. There is much stammering; early loss of incisors (indicating epithelial infections); unusually wide thumbs; "considerable mental powers," though doubtless morbid as shown by "excessive sex interest," etc. In this family there are "several individuals abnormal in their sensitivity to odors."

It so happens that two sisters are reported to have a normal sense of smell, though it is not indicated whether this diagnosis is based on their own statements or on some form of examination. At least such conclusions only approach desired accuracy when based on simple measurements with an ordinary olfactometer. One brother has complete anosmia and another is said to exhibit the condition to a certain degree. The mother of these sibs and her father were reported as cases of complete anosmia. Such reports, Glaser believes, show 'offhand, certain resemblances to sex-linked inheritance." There was also "smell-blindness" (an unfortunate expression used by Blakeslee[2] and going dangerously well with sex-linked inheritance) in certain members of a collateral line.

After inquiries the young man examined by Dr. Glaser finds that the defect is "inbred" in the locality from which he comes "so that quite a number are afflicted with it."

I am certain that Dr. Glaser will pardon me for taking the liberty of questioning the value of this record from a genetic standpoint, and of pointing out certain serious objections to it.

In Poland, parts of Russia around Kiev, Galicia and Hungary it is well known that the serious disease rhinoscleroma, first described by Hebra in 1870, is endemic. Such a disease readily destroys the olfactory epithelium beyond repair. Rhinoscleroma does not occur in the United States except among immigrants from the above regions; several cases have been described by Emil Mayer[3] in New York City. In addition to this marked disease, various forms of chronic rhinitis causing congestion and fibrous thickening of the nasal epithelium are extremely common among Russian Jews, as well as other races of Russian and Poland. Nasal polypi actually modifying the form of the external nose and also causing anosmia are common. Several of these diseases and catarrhal conditions occur somewhat more frequently among men than women owing to greater exposure to colds and general nasal infections.

My attention has frequently been attracted to these facts during a number of years' experience in the anatomical dissecting room. One often notices among Russian Jews a lack of the sense of smell to such a degree as to be unable to detect the ordinary strong odors of embalming fluids, etc. Many such persons have chronic rhinitis or other affections of the turbinal regions which tend to destroy or cover over the olfactory epithelium of the upper nose, causing a loss of the sense of smell even when very young.

It would seem rather probable that the family described by Glaser presents anosmia among its members as a result of diseased conditions. Evidence derived from the prevalence of even rhinoscleroma along with many ordinary nasal affections, in the region from which the examined man came, also points more directly to disease as an explana-

[2] "Unlike Reactions of Different Individuals to Fragrance in Verbena Flowers," SCIENCE, N. S., Vol. XLVIII., p. 298, September 20, 1918.

[3] "Scleroma of the Larynx," *Am. Jour. Med. Sci.*, N. S., CXXXIII., p. 751, 1907. "Rhinoscleroma in North America," *Laryngoscope*, December, 1908.

tion of the number of persons exhibiting anosmia in this community, than to some form of inheritance.

I wish in no way to be understood as opposing the belief that deficiencies in the sense of smell may be inherited in human beings. On the contrary, it seems certain that defects in the sense of smell must be inherited, since this sense in man is so degenerate as to be vestigial in function, often strangely one-sided in its manifestations, or even completely wanting. The extent to which the sense is developed varies greatly among individuals. Many persons with apparently normal olfaction are actually unable to appreciate certain particularly pungent odors such as those of violets, or hydrocyanic acid, etc.

In deciding the cause of deficient olfaction it is most important to recognize the favorable location for exposure to disease of the olfactory epithelium. Any attempt to determine the manner of inheritance of the different degrees of anosmia, therefore, must necessitate a careful examination of the nasal epithelium in all so-called abnormal individuals in order to detect the vitiating effects of disease.

In heredity studies of no other sense would such considerations be more important than in investigations based on the degree of efficiency of the sense of smell. Diseases of the nasal epithelium are often but slightly contagious thus affecting only certain members of a family, and on account of greater exposure, more probably the male members, as in the family now considered. Some diseases of the nasal passages as rhinoscleroma are endemic in certain regions and might cause secondary conditions which would seem to be "inbred" in the community.

Anosmia is known among women as well as among men, though probably more often in the latter. Until, however, there is statistical evidence indicating a decided preponderance of the defect in one sex, when not the direct result of disease, there is no reason in the absence of further genetic data for assuming the condition to be sex-linked in inheritance. Anosmia is in no way comparable to color-blindness as the expression "smell-blindness" might suggest. It is comparable only to defective sight or actual blindness when this is due to either retinal, nerve, fiber-tract, or cerebral center deficiency.

CHARLES R. STOCKARD
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QUOTATIONS

THE ORGANIZATION OF RESEARCH IN GREAT BRITAIN[1]

THE Committee of the Privy Council for Scientific and Industrial Research has published its third annual report (for the year August 1, 1917, to July 31, 1918).[2] Practically it is a new government department which administers the Imperial Trust for the Encouragement of Scientific and Industrial Research. During the last financial year the committee expended £30,825, and it is convinced that the value to the nation of the work done is beyond all comparison greater than the cost, and will, as time goes on, bring continually augmented returns, for the garnering of the harvest of research is sure though slow. The estimated expenditure for the current financial year is £163,350, which includes a sum of £89,750 for the National Physical Laboratory. In addition, the laboratory is rendering services to the several war departments, which will be met out of the vote of credit, at an estimated cost of £74,100. The grants in aid of industrial research associations will be met out of the fund of one million held by the Imperial Trust.

The report by the Advisory Council, of which Sir William McCormick is chairman, and Sir Frank Heath, K.C.B., secretary, gives an account of the progress made in the establishment of these associations and the steps that have been taken in the organization of national research. Some thirty industries are

1 *British Medical Journal.*

2 "Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1917–18." H.M. Stationery Office. Price 4d. net. (Cd. 9194.)

actively engaged in establishing such associations, and licences have already been issued by the board of trade to three. Among them is the British Scientific Instrument Research Association, founded through the efforts of the optical industry; the department has guaranteed a total expenditure by this association, in accordance with an approved scheme, of not more than £40,000 during the first five years. In accordance with the terms of the agreement with the Royal Society, the department became responsible for the maintenance of the National Physical Laboratory on April 1, and has given special attention to the salaries of the scientific and technical staff. Hitherto the laboratory to balance its expenses, has been obliged to rely in the main upon fees paid to it for testing; as a result its officers have been seriously underpaid, and the best of its senior men are continuously being attracted away from it. It is now recommended that the scales of salaries should be completely overhauled, and that adequate provision should be made for superannuation.

One of the subdepartments through which the Department of Industrial and Scientific Research works is the Food Investigation Board, of which Mr. W. B. Hardy, secretary of the Royal Society, is director. This board has several subcommittees—on fish, on meat, on fruit and vegetables, on oils and fats, and on engineering. It has been giving particular attention to the preservation of food, especially by cold storage. It is acting in close consultation with the Food (War) Committee of the Royal Society, and the work has grown rapidly. On this head the report contains the following significant observation: "Events have justified the rapid decisions which we took in the summer of last year, while experience has shown that the appointment of a responsible director to organize a group of researches of national importance assisted by an advisory board of distinguished men of science and affairs greatly facilitates prompt action and the proper coordination of all the work in accordance with a definite scheme. Research work, like other forms of creative activity, will not flourish under committee rule."

Last year, at the invitation of the Home Office, the department appointed a committee, of which Dr. J. S. Haldane is a member, to inquire into the types of breathing apparatus used in coal mines. This committee has just presented its first annual report,[3] in which it draws attention to certain serious defects in existing mine rescue apparatus, and in the training of men to use them. The defects, it is stated, are mainly matters of detail, and suggestions are made for their improvement, for the fixing of standards of achievement, and for preparing the ground for further progress in experimental investigations. Experimental work is being carried on for the committee at the Heriot Watt College, Edinburgh, under the direction of one of its members, Dr. Henry Briggs, who has established a physical testing station which will be run by a military staff attached to the Scottish command. For the War Office the committee has examined and reported on several sets of captured enemy breathing apparatus, and has advised that special inquiries should be made into the storage and supply of liquid and compressed oxygen, and other gases. In conjunction with the Admiralty and the War Office a research clearing house committee has been appointed to coordinate the investigations into gas problems conducted by the different departments, and to ensure rapid interchange of knowledge and experience, questions of particular difficulty being referred to the science department.

The department has also established, jointly with the Medical Research Committee, an industrial fatigue research board with Professor Sherrington as chairman. With the board is associated a panel of representative men and women from each of the industries being studied, who will join the board as each trade in turn comes under review. It will investigate "the relations of the hours of labor and of other conditions of employment, including methods of work, to the production of in-

[3] Department of Scientific Industrial Research. First Report of the Mine Rescue Apparatus Research Committee. H.M. Stationery Office. Price 1s. 9d. net.

dustrial fatigue, having regard both to industrial efficiency and to the preservation of health among the workers." Grants are made to aid researches undertaken by independent bodies and also to individual students in research work; in making them the council has been guided by its knowledge of the quality of the research work undertaken by the professor or head of the department who recommends the student.

In referring on a previous occasion to the work of this new department we expressed the hope that though it was primarily established to encourage the application of scientific research to industrial methods, it might become the rallying point of other scientific branches subsidized by the government, eventually developing into an independent Ministry of Science. These hopes have been realized to a considerable extent, and we find no evidence that the department is regarded as a temporary expedient. Indeed, another step forward has been taken which we hardly dared to anticipate. The annual report of the department contains a series of paragraphs relating to the development of the organization of research in the Overseas Dominions. The home department has been in close touch with the Canadian Honorary Advisory Council for Scientific and Industrial Research, which was incorporated by a Canadian Act of Parliament a year ago. This Canadian council has promoted many valuable researches and inquiries, some of which have already produced important results. Again, in Australia, an Advisory Council of Science and Industry has been established, and has started a number of investigations which have aroused the active interest of manufacturers and others likely to benefit by the systematic application of science to industry. The New Zealand government took initial steps to organize scientific and industrial research as long ago as 1916, but the matter does not there seem to have passed beyond the stage of discussion. In South Africa there is an Industries Advisory Board, which deals not only with scientific and industrial research, but also with statistics of production, factory legislation, the encouragement of industries, and the development of natural resources. Finally, it is the intention of the government of India to establish after the war an Industrial Board and Department, which will succeed the Indian Munitions Board and extend its sphere of operations. As the chairman of that board has pointed out, munitions for a modern army cover practically all the wants of the civil community. It is also to be noted that a National Research Council was established in the United States of America in 1916, under the auspices of the National Academy of Sciences, and largely through the initiative of its president, Dr. Welch, and of Professor Hale. This council, as we have shown on previous occasions, did much valuable preparatory work before America entered the war, and since then it has so grown in usefulness and power that President Wilson has issued an executive order putting it upon a permanent basis.

The letter in which the Lord President, Lord Curzon of Kedleston, presents the report of the British Advisory Council to the King in Council, concludes as follows: "The foundations of a national system of scientific research are being truly laid. In the final structure as they (the Advisory Council) are planning it, the universities and technical colleges, the learned societies and the industries will be found taking their due place; not in subordination to the state, as our enemies like to see them, but working together for the common good in helpful cooperation."

SPECIAL ARTICLES

THE RELATION OF THE SECTOR OPENING OF THE SECTOR PHOTOMETER TO THE EXTINCTION COEFFICIENT

IN determining absorptions with a spectrograph and sector photometer it is necessary to know the relation existing between the sector opening and the extinction coefficient. If the two beams whose intensities are to be equalized by interposed sectors be donated by I and I' respectively, then

$$\log \frac{I}{I'} = e$$

defines e as the extinction coefficient of the

substance for which I' is the transmitted beam and I the corresponding incident beam. If these two beams, I and I', be equalized photographically by means of interposed rotating sectors, S and S', then some relation exists between I/I' and S'/S.

A previous determination by H. E. Howe[1] of this relation made

$$\frac{I}{I'} = \frac{S'}{S}$$

where S is the variable sector cutting down the beam I till it balances the beam I'. The equality was established by measuring with a sector photometer the transmissions of neutral smoke-glass plates, the transmissions of which had previously been measured on a visual spectrophotometer.

In further establishing the validity of this equality the method here employed has been to use likewise two beams of known relative intensities determined geometrically as a function of the relative distances of their sources from the slit of the spectrograph.

Using the Hilger quartz spectrograph, size C, in front of one half of a slit 3 mm. long there was placed a total reflecting prism whose face was illuminated through a variable sector by a fixed Nernst lamp. The illumination of such slight variations in voltage would be equivalent.

A series of exposures were made on successive portions of a plate with the movable lamp set at distances increasing by small increments. Such a series of exposures would then be expected to contain one at which the illumination by the movable lamp would balance that by the fixed lamp as judged by equal blackening of the spectrum bands on the plate.

The average distance for such a balance with the sector at rest, as determined by making settings with increments of half a centimeter, was about 40 cm. It was possible to estimate the true distance to tenths of a centimeter. With the sector running corresponding settings of the movable lamp were made for various openings of the sector, the principal openings being 7.3°, 10° and 19°. The following table gives the results for these openings, the figures being all reduced to a common denominator by dividing the distance of the movable lamp from the slit by the initial distance at which the two beams balance with the sector at rest. The figures are arranged in rows according to the sector opening and in columns according to the individual plates and set ups of the apparatus.

Sector	Distance Observations	Average	Theoretical $\frac{I}{I'} = \frac{S'}{S}$
19°	432, 432, 443, 439, 444, 437, 432, 436, 438, 441, 440, 440	438	435.4
10°	617, 596, 591, 596, 591, 610, 591, 600, 600, 614, 614	602	600
7.3°	712, 690, 695	699	702

the other half of the slit was accomplished by another Nernst lamp arranged on a runway in the axis of the collimator so that its distance from the slit could be varied at will.

The lamps were on the same 110-volt alternating current, city circuit, and plates were always made under such conditions that the voltage did not vary more than two volts during the course of an experiment. The lamps being of the same construction it seemed reasonable to suppose that the simultaneous variations in candle power of the two lamps due to

The apparatus was taken down and realigned several times in order to eliminate any systematic error. Considerable care was taken to have the spectrograph and runway level, and to have the runway so that the Nernst filament remained in line with the collimator axis. This was accomplished in some instances by halving the distance between the two points at which the spectrum disappeared in shoving the lamp from side to side, and in some instances by placing the filament at one end of the runway in contact with the slit, at the other end making a symmetrical shadow of the collimator

[1] H. E. Howe, *Phys. Rev.*, VIII., 6, 1916, 674.

tube on the spectrograph body. The Nernst filament was placed vertically. It was used at such a distance from the slit that at its nearest position to the slit the whole of it was effective in illuminating the plate.

The graduations of the sector opening were compared and corrected with a protractor. The sector wheel ran 120 revolutions per minute, there being two openings in the wheel, the sum of the two being an angular opening equal to that given in the table.

The plates used were half of them Wratten & Wainwright Panchromatic and half Seeds Panchromatic. In one instance a Seeds Process was used with the same results. The plates were given uniform tank development. The exposures were such as to give rather faint images, necessary in order to judge accurately differences in intensity. The exposures were such, however, that with the sector running they were always longer than one minute. A plate would contain a set of exposures for the so-called zero of the experiment, the initial balance distance, and a set of exposures with the sector running, the movable lamp being placed at distances such as to make equivalent sets of exposures. The distances corresponding to the two pairs which matched on such a plate when divided the one by the other gives a quotient which is a figure of the table. With a good setting the two spectral bands balanced throughout if they balanced at all, showing that the proposition is independent of wave length.

As the sector photometer is used for spectrophotometry the two beams fall on a bi-prism in front of the slit with the result that the two beams on the plate are in juxtaposition. Because of the fact that the total reflecting prism used here had been slightly ground on its edges the two bands of the pair in this experiment were .4 mm. apart, which increased somewhat the difficulty of judging equality in blackening. The error in such judgments was probably of the order of 2 per cent. It may have been less than this. The averages for the figures of the table differ as the last two columns show by about a half per cent. from what the figure should be if the diminution in the intensity of the beam due to the sector is photographically equivalent to the diminution due to a proportionate increase in distance.

That this equality exists is certainly a coincidence. Recently Helmick[2] has shown that long exposures produce less blackening than short exposures, the total energy being the same (this being when both the short and long exposure are longer than a certain fixed time). In some rough experiments which I first made I found that the total actual intermittent exposure necessary to produce equal blackening through a 72° sector was about of the order of 12 per cent. longer than for a like continuous exposure, *i. e.*, the sector at rest. The evidence herein contained goes to show that when the beam is dimmed by increasing the distance of its source the exposure must likewise be longer by this same amount. In other words, if B_1, B_2 and B_3 are the blackenings due respectively to a certain beam, to the same beam made intermittent and to a beam of decreased intensity, all of the beams delivering equal total energy through the regulation of the time factor, then B_2 and B_3 are less than B_1 but are equal to each other.

H. S. NEWCOMER

THE LABORATORY OF THE
HENRY PHIPPS INSTITUTE OF THE
UNIVERSITY OF PENNSYLVANIA

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

THE seventh annual meeting of the American Association of Variable Star Observers was held at the Harvard Observatory, Cambridge, Mass., on November 23, 1918. More than a score of the members were present and the association became formally incorporated under the laws of Massachusetts. The meeting was, without doubt, the most successful and enjoyable that has yet been held. The reports of the several committees indicated the active interest and aims of the members, and a new committee, under the chairmanship of Professor S. I. Bailey, was appointed to gather together a collection of astronomical slides which could be loaned, under proper supervision, to members who might care to lecture in their vicinity, thus tending to arouse a greater interest in astronomy and particularly variable stars.

[2] P. S. Helmick, *Phys. Rev.*, XI., 5, 1918, 372.

Several prominent authorities on variable stars were elected to honorary membership, including Miss H. S. Leavitt, of the Harvard Observatory; Professor S. A. Mitchell, director of the Leander McCormick Observatory; Professor H. C. Wilson, director of the Goodsell Observatory, and editor of *Popular Astronomy;* Mr. C. L. Brook, director of the Variable Star Section of the British Astronomical Association, England, and Professor A. Bemporard, director of the Observatory, Catania, Italy. Mr. C. E. Barnes, who has been most generous in acting as publisher for the association, was elected as the second Patron.

A pleasant feature of the meeting was the presentation to Professor E. C. Pickering of a solid gold paper knife, set with appropriate jewels, as a token of the esteem in which he is held by the association. President D. B. Pickering most graciously presented the token, in substantially the following language:

Members and friends of the A. A. V. S. O.: It is my very happy task, at this time, to act for you in the performance of a duty of true friendship and appreciation.

At the time our association was formed, seven years ago, its course was decided and its fate determined largely by the influence of one man. Whatever he may have hoped to win for science from our efforts at that time or since, can not be commensurate with the sacrifices that he has made in our behalf.

He has assisted us in everything that we have undertaken and has carefully watched our progress along every step of the way. And the manner of his so doing has been that of the big brother.

For us he has laid aside the cloak of the physicist and master of research, and has given us his hand in fellowship, has taken us into his home, seated us at his board, and been one of us.

Professor Pickering, our attempt to convey to you at this time some feeling of appreciation for the big thing you have done for us, seems very weak and inadequate: but we want you to know that with the little token we are shortly to ask you to accept, there goes to you from each and every one of us the warmest feeling of friendship and goodwill.

There is a precious stone called the alexandrite, that has the rare property of appearing green in the light of day and red under artificial light, and well symbolizes the colors of the stars at their evolutionary extremes. There is also another, called the star-sapphire, wherein nature, in a manner with which we are unfamiliar, has set a star against a background of azure. Both of these gems are mounted in this little remembrance.

The inscription reads: "Edward Charles Pickering, Director of the Harvard College Observatory, from the American Association of Variable Star Observers, November 23, 1918," and the reverse reads: "This token of appreciation is tendered to him who has done so much to promote the study of variable stars: guiding the amateur with untiring helpfulness along paths of understanding into fields of usefulness and pleasure."

Will you accept it, sir, and with it the gratitude we have tried to express.

Professor Pickering, though taken completely by surprise, responded in his usual characteristic manner and expressed his great appreciation to the association for such an expression of friendship and gratitude, and added that he had felt all along, that he and science were the ones that were being helped by the untiring efforts of the members of this association.

Mr. D. B. Pickering's address as retiring president, was a model of clearness and explicitness and dealt thoroughly with the aims and purposes of the association, what it had accomplished in the past seven years, and what it hoped to do in the future.

The climax of the meeting came at the sumptuous dinner held in the evening, at a private house near the observatory, where in the absence of the newly elected president, Mr. Campbell, acted as presiding officer and toastmaster. The after-dinner speeches, both of an astronomical and non-astronomical nature, were greatly enjoyed by all.

The newly elected officers are: *President,* H. C. Bancroft, Jr., of West Collingwood, N. J.; *Vice-president,* C. Y. McAteer, of Pittsburgh, Pa.; *Council Members for two years,* Miss A. J. Cannon, of Harvard Observatory, and Professor C. E. Furness, of Vassar College Observatory. W. T. Olcott and A. B. Burbeck continue to serve as secretary and treasurer, respectively, and Professor A. S. Young and J. J. Crane have another year to serve on the council.

For the members who could remain in Cambridge until the next day, a visit was made to the Students' Astronomical Observatory at Harvard College, where Dr. Stetson most graciously and thoroughly explained the elaborate devices that are being used there to teach astronomy to the rising generation.

The spring meeting will be held on the first Saturday in May, 1919, in East Orange, N. J., at the invitation of Mr. D. B. Pickering.

L. C.

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THE UNIVERSITY AND PUBLIC HEALTH[1]

"THE end of our foundation is the knowledge of causes, and secret motions of things; the enlarging of the bounds of human empire, to the effecting of all things possible." In these words Francis Bacon in "The New Atalantis" summed up the aims of what he called "Salomon's House" or the "College of the Six Days' Works." Plato dreamed of a society dominated by guardian philosophers; Sir Thomas More pictured a happy people practising an economic communism; Bacon imagined a sage civilization obedient to science; he had faith in social progress by research and education. He foreshadowed with astonishing vision the essential features of the modern university.

Salomon's House was lavishly equipped with buildings' apparatus and other facilities which would fill one of our faculties with joy, and a board of trustees or a legislature with consternation. There were caves, mines, lofty towers, lakes, hydraulic works, laboratories, orchards, gardens, kitchens, sound-houses, perspective houses, furnaces, mechanical shops, "dispensatories with shops of medicine," parks for animals "not only for view or rareness, but likewise for dissections and trials that thereby may take light what may be wrought upon the body of man." All this reads like the prospectus of a Western State University with a department of Agriculture and a standardized Medical School. The University of New Atalantis

[1] Abstract of an address delivered at the anniversary exercises of Johns Hopkins University, Saturday, February 22, 1919, by George E. Vincent, president of the Rockefeller Foundation.

was also a source of mechanical inventions which until the other day seemed to us fantastic. "We imitate also" says the complacent president of Salomon's House "flights of birds: we have some degree of flying in the air. . . . We have ships and boats for going under water . . . ". Here was a department of engineering to coax endowment or release appropriations!

But this is not a company to be interested in mere material things. The Hopkins tradition sets store not by buildings but by men. In the personnel and organization you will not be disappointed. Twelve traveling fellows were always abroad, exchange professors gathering information, books and apparatus. In residence, three men prepared catalogues of experiments; other three made lists of mechanical discoveries; a third triumvirate, known as "pioneers" undertook new investigations; then expert compilers assembled all results systematically. At this point there was a differentiation into applied science and pure research. On the one hand, fellows called "benefactors" worked out practical utilities for daily life. On the other, after general staff consultations, three advanced specialists planned further investigations which were carried out by the most skillful researchers called "inoculators." The work was crowned by "interpreters of nature" who "raise former discoveries into greater observations, axioms and aphorisms." We may smile at the elaborate division of labor and the quaint titles, but we realize that Queen Elizabeth's pliant courtier had firm hold upon the real substance of scientific research.

The College of the Six Days' Works was not wholly a cloistered center of pure investigation. It had a university extension department which maintained "circuits of visits of divers principal cities." Peripatetic lecturers published "such new, profitable inventions as we think good." There were specialists who gave advice about diseases, plagues, noxious insects, earthquakes, inundations and other disconcerting phenomena. These counsellors were apparently like our county-agricultural agents, and public health officials. This much is significant. Salomon's House dealt directly with the ultimate consumers of scientific information and expert advice. The popularizing middle man who purveys what a fastidious friend calls "Sunday Supplement Science" seems not to have been known in the "New Atalantis."

The ideals which Bacon cherished three hundred years ago are our guides to-day: the area of man's scientific interest worldwide; the search for truth in itself a noble end; the training of scholars a means at once of social inheritance and of leadership; the application of knowledge to the common, daily life an inspiring service; the diffusion of education a condition of progress. To promote these things is the purpose of the modern university. During the last fifty years in the United States rapid advance has been made in the material equipment of our universities. The inner intellectual and spiritual development has been a slower growth. The older institutions have made important contributions. To this honored university whose beginnings we celebrate on this anniversary this nation owes a debt of gratitude. Here a group of high-minded and devoted scholars established a tradition of pure research which has profoundly affected higher education in this country, and has been recognized beyond our borders. Salomon's Houses have been firmly founded in another Atalantis.

It is to be noted that university methods and spirit are gradually drawing under their influence almost every phase of education. Engineering training of the highest

type has either come under university control or is carried on in separate schools which have themselves adopted the ideals of higher education. The teaching of law as an inductive discipline under university auspices has steadily discredited the didactic methods of proprietary schools. Agriculture as an administrative art based upon a scientific knowledge of physics, chemistry and biology has had its chief development in the large state institutions which centralize public higher education for a whole commonwealth. Modern medicine has become so imbued with the university spirit and is so dependent upon scientific method and university resources that the independent, proprietary, practitioner-manned school is virtually a thing of the past. Dental education is advancing steadily toward university affiliation. Schools of education, business, journalism, training for socal service, are all apearing as university departments.

The American university has stood well the searching tests of war. Undergraduates have given good account of themselves on land and sea. Alumni have put their technical training and administrative skill at the disposal of their country, and university professors have come to their own. They were found in every service. Physicists have invented submarine detectors and eardrum protectors; chemists have created deadly explosives, noxious gases, new dyes; psychologists have tested aviators, classified recruits and devised methods of vocational selection; historians have prepared patriotic propagandist material, and are at the Peace Conference now fairly brimming with information geographical, racial, economic, political. University laboratory and clinical men have been a tower of strength to the medical service of the government. They have discovered new germs, produced sera and vaccines to protect the soldier; they have worked out new methods of surgery; they have promoted camp sanitation and have improved hospital care. I shall never forget that May morning last year in France when General Finney—he was only a major then—showed me over the Hopkins Base Hospital which lay under the trees on the slope of a lovely valley. "Tell the people at Home," he said, "that the boys will get a little better care here than they would if they were in Baltimore." Could a loyal Hopkins man say more?

The American university, then, emerges from the war with a new sense of confidence and of social obligation. This does not mean that the university is self-satisfied. It recognizes that many changes must come. Entrance requirements, undergraduate studies, forms of organization, the status and salaries of college teachers, the rivalry between the types known as the "mere teacher" and the "research man," the spirit and attitude of governing bodies, the conventionality of much graduate work—all these raise problems which must be dealt with. Nevertheless, the essential university ideals and methods have vindicated themselves. Especially is this true in the field of medicine. The university laboratories in charge of full-time workers with adequate equipment and assistance, the completely controlled hospitals and out-patient departments supplemented by community workers and visiting nurses, clinical research and teaching under full-time leadership, cooperation in investigation through staff conferences, the fostering of ideals of research, publication, training and social welfare, are the characteristic features of modern medicine which discards the labels and shibboleths of outworn schools and factions.

As was natural, public health policies and information about epidemics developed for the most part independently of universities. Medical men were to be sure from the outset concerned in public health pro-

cedures which had to do chiefly with quarantine, fumigation, water supplies and sewerage. Under pioneer conditions and in small communities there was little or nothing that could be called public health administration. With the growth of urban population more acute situations developed, but not until the discoveries of Pasteur did the knowledge exist upon which to base effective policies and procedures. Since then university laboratories have played an important part in the creation of the science of preventive medicine. It has been increasingly true that university-trained men have made contributions in this field. This is not to deny that conspicuous triumphs have been achieved by medical men whose training was not distinctively of the later university type. Their methods were based upon the results of research carried on in the true university spirit. Before the war there was widespread and increasing interest in public health, due to striking success in sanitation in Cuba and the Canal Zone, to the work of the U. S. Public Health Service, and of state and municipal officers, to the agitation maintained by numerous voluntary public health societies, and to demonstrations such as those carried out by the International Health Board in the control and prevention of hookworm infection.

The war has revealed facts, afforded opportunities and made possible demonstrations which have advanced the cause of public health in many ways. The large percentages of men rejected by the recruiting offices and draft boards caused surprise and alarm. The examination of millions of men afforded valuable data. Camp sanitation and health supervision of military zones offered unusual opportunities for controlled experiment. The handling of epidemics tested the resources and widened the experience of health officers. Hospital organization and administration were undertaken on a vast scale. The psychiatrists gained recognition for mental hygiene not only as a means of dealing with individual cases but as an organic part of public health, applicable to large groups. The policy adopted by the government with respect to venereal diseases and the vigorous campaigns against them carried on both at home and in France have resulted in statistical data and other records unique in the history of preventive medicine. The medical care of millions by salaried physicians and surgeons has been an object lesson in social medicine and has made more vivid the idea of health as an attribute of masses of men living a common life. Studies in munition and other warwork factories have dealt with occupational diseases, fatigues, night work, nutrition, labor of women and other phases of industrial hygiene. Communities, states and nation are ready as never before for a forward movement in public health.

All signs point to a rapid extension of public health activity in many fields. The federal, state and municipal bureaus and boards are in need of trained personnel. Voluntary associations call for experienced leadership. The outlook for industrial hygiene is bright. Employers are likely increasingly to regard the sanitation of factories and stores and the health supervision of employees as necessary features of sound business management. For such work specifically prepared types of officers, physicians, physical directors and nurses will be required. School hygiene bids fair to play a larger part in our educational system. All of these movements will create a demand for a great variety of specialists. The success of the whole national public health program which has been comprehensively outlined by the United States Public Health Service will depend quite as

much upon the securing of a properly trained personnel as upon the appropriation of adequate funds. The apprenticeship system of the past, the trusting to good fortune in finding medical men who have the imagination and energy to make themselves into public health officials will no longer serve our needs. Specialized agencies of training must be provided.

In response to this demand for a trained personnel for public health administration universities began some time ago to offer special courses. Pennsylvania took the lead in 1909, followed the next year by Harvard and the Massachusetts Institute of Technology which cooperated in establishing a curriculum. By 1915 eight other institutions were giving more or less attention to the training of public health officers. As was to be expected there was no uniformity in requirements or curricula, no standardizing of degrees. A premature agreement on these points would have been unfortunate. In every case the importance of practical work was recognized. For example at Harvard the opportunity to cooperate with Massachusetts towns and cities in making health surveys and in providing field experience for prospective health officials was wisely utilized. The new plans of the Harvard Medical School for research in occupational diseases, for demonstrations in industrial hygiene in connection with factories and stores, for the training of a special personnel and for the publication of a journal are significant of the university attitude toward the problems of public health.

It is in the keeping with the spirit of this university that a serious attempt should be made here to establish on an adequate basis the training of public health officers, laboratory men, specialists in epidemiology, field workers of all kinds, public health nurses and others. The School of Hygiene and Public Health which opened its doors last October is a typical university-institution. While it is closely related to other divisions of the university, notably the medical school, the hospital, the engineering department, the courses in law and the social sciences, the new school is in no sense subordinate to any or all of these; it has its own individuality, its own faculty and student body, its own quarters and equipment, its own *esprit de corps*, its own professional point of view. It will have relations in the field with federal, state and local health administrations for purposes of practical training. It already counts among its leaders men of distinction in several fields of public health; it is seeking others who will round out the staff and man every phase of work which bears fundamentally on the problems of preventive medicine both in the laboratory and in the field.

The new school will not only provide thorough courses in the fundamental chemical, biological and medical subjects in their many specialized phases, but will lay stress upon vital statistics, upon sanitary engineering, upon the sociological aspects of public health, upon community surveys, upon the technique of administration. It is significant of the new attitude toward preventive medicine that from the outset attention is being given to the problems of nutrition. It does not seem prematurely philanthropic to establish, if possible, such basic norms for human beings as have been in some degree worked out for hogs and cattle! Prevention is being more and more positively interpreted into a better standard of living, in terms of working conditions, housing, food, exercise, recreation, sociability and happiness. The field of industrial hygiene has great possibilities. A modern school of public health will inevitably be compelled to widen its scope and to extend its interests with the develop-

ment of the theory and practise of social welfare. A fascinating vista opens before men and women of trained intelligence, controlled imagination, and social loyalty.

There are problems with respect to which the new school will be expected to furnish light and leading. One of these is the definition of the functions and the training of the public health nurse. Is she expected to be able to practise medicine or is she merely the long arm of the physician? Should she be a graduate nurse of a regular hospital training school with additional education and experience in sociology and field work? Or should she be a new kind of social worker, a "health visitor" without hospital training? Can a new course be arranged to include a special form of hospital experience, courses in preventive medicine, statistics, sociology, administrative law and practical field work under supervision? If so, how many years should be set aside, what sort of preliminary training should be required and how can existing agencies be induced to cooperate in providing a new curriculum? Questions like these are pressing for answer. Attempts are being made to reach a consensus. Several groups of institutions are anxious to make the experiment. Here is an opportunity to take the lead in establishing a normal school for public health nursing which could help to supply teachers and superintendents for the nurses' training centers which seem likely to develop in various parts of the country.

You may not have forgotten that the university of New Atalantis engaged directly in extension and publicity work. It went to the popular circuit with practical information. What is the duty of the modern university in this regard? The academic and the advertising minds are not congenial. The former by scrupulously logical means slowly reaches tentative conclusions: the latter dogmatically "puts things across" and "sells an idea" to the public. Thus patriotic advertising men during the war rallied to the aid of the government: they "sold" the war, liberty bonds, the Red Cross, Thrift Stamps to the American people. That is, by infectious slogans, adhesive shibboleths, vivid posters, and "four-minute" hypnosis, certain motor ideas were fixed and held in millions of minds until action was secured. All this is apt to fill the sensitive soul of the scientifically-minded man with a kind of protesting dismay. He sees ready-made conclusions dramatically impressed upon a whole nation. The fact that he agrees for the most part in the conclusions and welcomes the outcome, does not reconcile him to the method. He is quite sure that it would be impossible for a university to do this sort of thing.

One can understand this feeling and yet realize that the progress of public health in a democracy depends directly upon "selling the idea" to the public. The experience of various state boards and voluntary societies in this country; the public health campaigns of the Red Cross and the International Health Board in France have proved that vivid and picturesque publicity, verbal and visual, accomplishes valuable results. Shall work of this sort be left to independent advertising experts and popularizers, or shall universities recognize the art of applied mass-psychology, and consciously train men and women to organize and administer campaigns of popular eduction in preventive medicine? One can imagine complete collections of posters and other materials, prize competitions for new devices and propagandist literature, training in extempore speaking on various phases of public health—all conducted under the auspices of a school of public health. I merely raise the question. I am

too good a psychologist to attempt to "sell" this idea to an academic audience.

In a time when many things seem uncertain, and there are some reasons for grave anxiety, hope and courage are found in the idea of the university, a center of research, of scientific idealism, of professional pride, and of loyalty to the community entering the field of public health. Here men and women are to be trained to serve their fellows, to help to bring in a better social order in which health shall be interpreted in ever wider and nobler ways. We cling still to the dream of Francis Bacon, the vision of a people served by a brotherhood of scholars who give themselves gladly that knowledge may enrich and bless the lives of all. May the American university strive always to deserve the verdict of the citizens of the New Atalantis upon Salomon's House, "the noblest foundation, as we think, that was ever upon the earth, and the lantern of this kingdom."

GEORGE E. VINCENT

THE MEASUREMENT AND UTILIZATION OF BRAIN POWER IN THE ARMY, II.

Military Applications of Mental Ratings.—The sample distribution curves of Fig. 1 indicate the value of mental ratings for the identification and segregation of different kinds of military material. The illiterate group of this figure was examined by means of Beta, all other groups by means of Alpha.

Comparison of various military groups distinguished from one another by actual attainment in the service shows that the psychological tests discriminate between these groups with definiteness. This point may be illustrated by reference to the percentages of men of different groups making A and B grades in Examination Alpha: officers, 83.0 per cent.; officers' training school candidates, 73.2 per cent.; sergeants, 53.4 per cent.; corporals, 39.7 per cent.; literate privates, 18.8 per cent. The comparison of measures of central tendency reveals equally striking differences. Moreover, within the officer group itself significant differences appear for different branches of the service.

The relation of success or failure in officers' training schools to intelligence ratings is exhibited by Fig. 2, in which it is to be noted that elimination through failure in the school increases rapidly for ratings below C +. Of men rating above C +, 8.65 per cent. were eliminated; of those below C +, 52.27 per cent. The data for this figure were obtained from three schools with a total enrollment of 1,375 men.

Similarly Fig. 3 shows the relation between success or failure in non-commissioned officers' training schools and intelligence ratings. The elimination increases rapidly for grades below C +. Of men rating above C, only 18.49 per cent. were eliminated; of men rating below C, 62.41 per cent. The results presented in this figure were obtained from four schools with a total enrollment of 1,458 men.

Increasingly extensive and effective use has been made of the psychological rating as an aid in the selection of men for officers' training schools, non-commissioned officers' training schools and other lines of training or service which require special ability. It has been convincingly demonstrated that the data of psychological examinations can readily be used to diminish the necessary elimination during training and thus to increase the efficiency of the schools.

The extreme differences in the intellectual status of army groups are fairly indicated by Fig. 4, which presents the data for groups whose military impor-

tance can not readily be overemphasized. Roughly, the groups in the upper half of the figure are important because of their relatively high intelligence and the mental

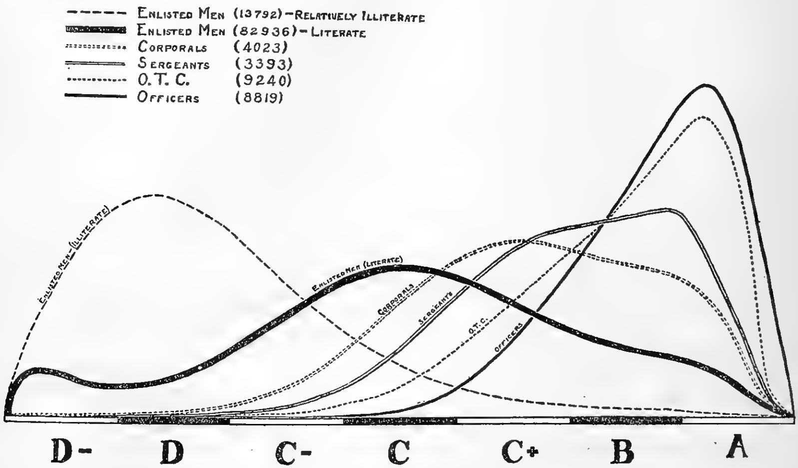

Fig. 1. The distribution of intelligence ratings in typical army groups, showing the value of the tests in the identification of officer material. The illiterate group given Beta; other groups Alpha.

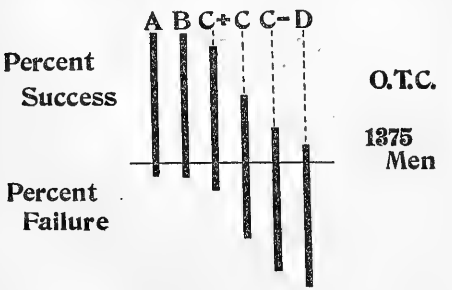

Fig. 2. Success and failure in Officers' Training Schools.

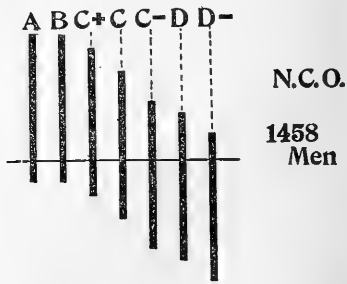

Fig. 3. Success and failure in Non-commissioned Officers' Training Schools.

initiative demanded for success, whereas those in the lower half of the figure are important because of poor intelligence and relative inefficiency or uselessness.

These results suggest that if military efficiency alone were to be considered, the army would undoubtedly gain largely by rejecting all D — and E men. This procedure would greatly lessen the group of disciplinary cases so troublesome and costly in the military organization and also the group which in the figure is distributed

among "ten poorest privates," "men of low military value" and "unteachable men."

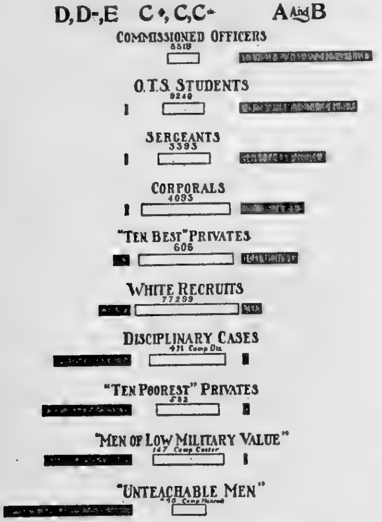

Fig. 4. Proportion of low, average and high grade men in typical groups.

Numerous varieties of evidence indicate the extreme military importance of the prompt recognition of low grade men. The percentages of men ranking below the average in psychological examinations are notably large for the disciplinary group, men having difficulties in drill, men reported as "unteachable" and men designated by their officers as "poorest" from the standpoint of military usefulness.

The comparison of negro with white recruits reveals markedly lower mental ratings for the former. A further significant difference based on geographic classification has been noted in that the northern negroes are mentally much superior to the southern.

The relation between officers' judgments of the value of their men and intelligence ratings is exhibited in somewhat different ways by Figs. 5 to 7. Thus the median scores for five groups of privates arranged in order of military value from "very poor" to "best" are presented in Fig. 5. The total number of individuals in the

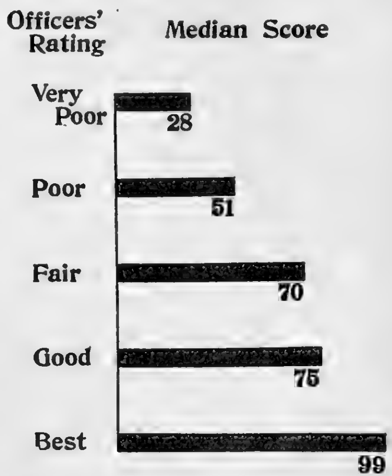

Fig. 5. Median intelligence scores of groups designated as "best," "good," "fair," "poor" and "very poor" in military value.

group is 374. The men were selected from twelve different companies, approximately thirty men in each company being ranked by an officer in serial order from "best" to "poorest." The rank order for each company was then correlated by the psychological examiner with the rank order supplied by psychological examination. In seven of the twelve companies the correlations ranged from .64 to .75. The average correlation was .536. These correlations are high, considering the large number of factors which may influence a man's value to the service.

The median score for the "very poor"

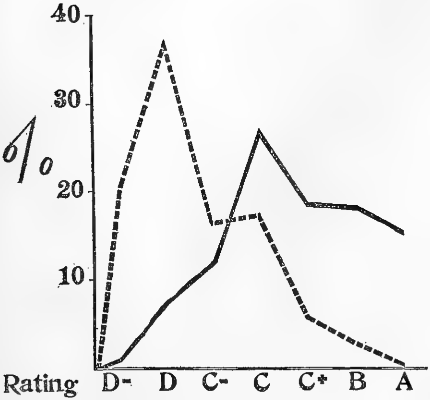

Fig. 6. Intelligence grades of "best" (——) and "poorest" (- - - -) privates. (Best, 606; poorest, 582; total, 1,188.)

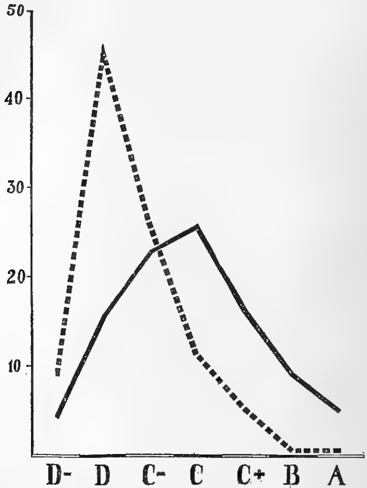

Fig. 7. Men of "low military value" (- - - -) (147), compared with a complete draft quota 12,341, (——).

group of Fig. 5 is 28 points in an examination whose maximal score is 212 points. By contrast with this, the median score of the "best" group of privates is 99 points.

The commanding officers of ten different organizations, representing various arms of the service, in a certain camp were asked to designate (1) the most efficient men in their organizations, (2) the men of average ability and (3) men so inferior that they are "barely able" to perform their duties.

The officers of these organizations had been with their men from six to twelve months and knew them exceptionally well. The total number of men rated was 965, about equally divided among "best," "average," and "poorest." After the officers' ratings had been made, the men were given the usual psychological test. Comparison of test results with officers' ratings showed:

(*a*) That the average score of the "best" group was approximately twice as high as the average score of the "poorest" group.

(*b*) That of men testing below C —, 70 per cent. were classed as "poorest" and only 4.4 per cent. as "best."

(*c*) That of men testing above C +, 15 per cent. were classed as "poorest" and 55.5 per cent. as "best."

(*d*) That the man who tests above C + is about fourteen times as likely to be classed "best" as the man who tests below C —.

(*e*) That the per cent. classed as "best" in the various groups increased steadily from 0 per cent. in D — to 57.7 per cent. in A, while the per cent.

classed as "poorest" decreased steadily from 80 per cent. in D — to 11.5 per cent. in A.

In an infantry regiment of another camp were 765 men (regulars) who had been with their officers for several months. The company commanders were asked to rate these men as 1, 2, 3, 4 or 5 according to "practical soldier value," 1 being highest and 5 lowest. The men were then tested, with the following results:

(*a*) Of 76 men who earned the grade A or B, none was rated "5" and only 9 were rated "3" or "4."

(*b*) Of 238 "D" and "D —" men, only one received the rating "1," and only 7 received a rating of "2."

(*c*) Psychological ratings and ratings of company commanders were identical in 49.5 per cent. of all cases. There was agreement within one step in 88.4 per cent. of cases, and disagreement of more than two steps in only .7 per cent. of cases.

Fig. 6 exhibits a striking contrast in the intelligence status and distribution of "best" and "poorest" privates. The personal judgment data for this figure were obtained from sixty company commanders who were requested to designate their ten "best" and their ten "poorest" privates. Of the "poorest," 57.5 per cent. graded D or D —; less than 3 per cent. graded A or B. The results suggest that intelligence is likely to prove the most important single factor in determining a man's value to the military service.

In one training camp excellent opportunity was offered to compare a group of soldiers selected on the basis of low military value with a complete draft quota. In the "low value" group there were 147 men, in the complete draft quota 12,341 men. The distributions of intelligence ratings for these two military groups appear as Fig. 7, from which it is clear that if all men with intelligence ratings below C — had been eliminated, the "low value" group would have been reduced by at least half.

In a certain training camp 221 inapt soldiers, belonging to a negro regiment of Pioneer Infantry, were referred by their commanding officer for special psychological examination. Nearly one half (109) of these men were found to have mental ages of seven years or less. *The army nevertheless had been attempting to train these men for military service.* In justice to the Psychological Service it should be stated that these negroes had been transferred from camps where there were no psychological examiners. For this reason they had not been examined before being assigned to an organization for regular training.

In another instance some 306 soldiers from organizations about to be sent overseas were designated by their commanding officers as unfit for foreign service. They were referred for psychological examination with the result that 90 per cent. were discovered to be ten years or less in mental age, and 80 per cent. nine years or less.

It has been discovered that when soldiers are assigned to training units without regard to intelligence, extreme inequalities in the mental strength of companies and regiments appear. This fact is strikingly exhibited by Figs. 8 and 9, of which the former shows the proportions of high grade and of illiterate or foreign soldiers in the various companies of an infantry regiment. Compare, for example, the intelligence status of C and E companies. The former happens to have received only 3 per cent. of A and B men along with 38 per cent. of illiterates and foreigners, the latter received by contrast 29 per cent. of high grade men with only 9 per cent. of men who are as a rule difficult to train. It is needless to at-

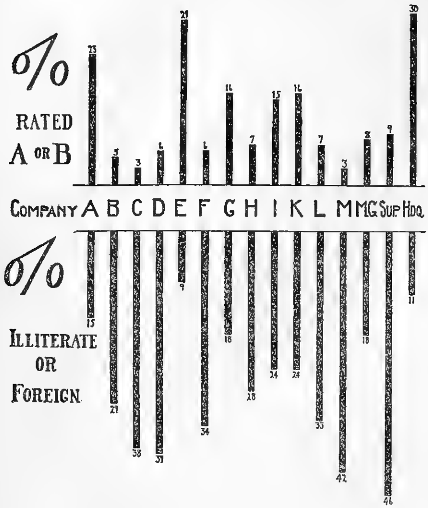

Fig. 8. Inequality of companies in an infantry regiment.

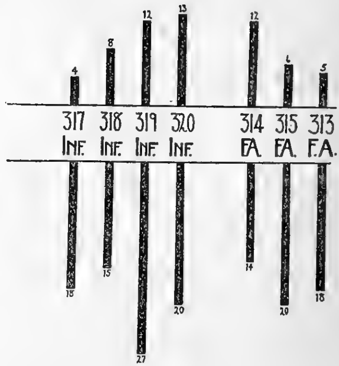

Fig. 9. Inequality of regiments.

tempt to emphasize the military importance of this condition. The tasks of the officers of these two companies are wholly incomparable, but more serious even than the inequalities in response to training are the risks of weak points in the army chain as a result of such random or unintelligent assignment.

Naturally enough the officers of the army were quick to appreciate the disadvantages of a method of assigning recruits which permits such extreme inequalities in mental strength to appear and persist. They promptly demanded the reorganization of improperly constituted units and assignment in accordance with intelligence specifications so that the danger of weak links in the chain and of extreme difference in rapidity of training should be minimized.

That serious inequalities existed in regiments as well as in smaller units prior to assignment on the basis of intelligence is proved by the data of Fig. 9, which pictures the differences found in four infantry regiments and three regiments of field artillery.

Following the demonstration of the value of psychological ratings in connection with assignment, the experiment was tried in various camps of classifying men in accordance with intelligence for facilitation of training. To this end A and B grade men were placed in one training group, C +, C and C — men in another, and D and D — men in a third. The three groups were then instructed and drilled in accordance with their ability to learn. Thus delay in the progress of high grade men was avoided and the low grade soldiers were given special instruction in accordance with their needs and capacity.

The marked differences in the mental strength of groups in different officers' training schools are shown by Fig. 10. For the eighteen schools of this figure, the propor-

tion of A grades varies from 16.6 per cent. to 62.4; the proportion of A and B grades combined, from 48.9 per cent. to 93.6 per cent.; and the proportion of grades below

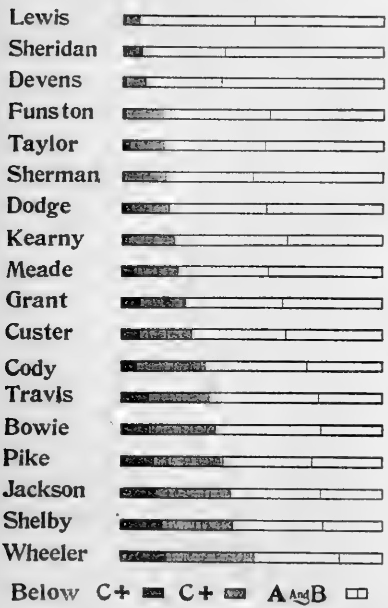

FIG. 10. Inequality of mental strength in eighteen Officers' Training Schools, 4th Series (total enrollment 9,240).

C+, from 0 to 17.9 per cent. Since it is unusual for a man with an intelligence rating below C+ to make a satisfactory record in an officers' training school, it is clear that the pedagogic treatment of these several student groups should differ more or less radically and that elimination must vary through a wide range if the several schools are to graduate equally satisfactory groups of officers.

Far more important than the contrast in student officers training groups noted above are the differences in the intelligence status of officers in different arms of the service as revealed by psychological examining. Fig-

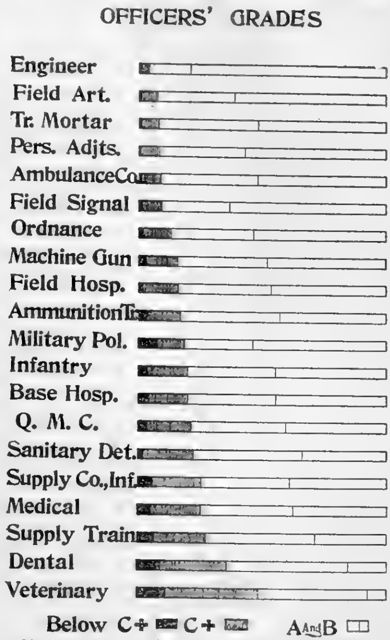

FIG. 11. Proportion of high and low grades in various officer groups.

ure 11 exhibits the data obtained for several groups. The variations are extreme and seemingly unrelated to the requirements of the service. Medical officers, for example,[1]

[1] Medical officers appear in the above graph under five headings: ambulance company (90 cases), fieldhospital (107 cases), base hospital (428 cases), sanitary detachment (50 cases) and "Medical" (378 cases). "Medical" in this case, is chiefly regimental detachments. When all five groups are combined medical officers *in general* take the place in the graph occupied by base hospital.

show a relatively large percentage of men rating C + or below, whereas engineering officers head the list with relatively few men whose intelligence is rated below B. There is no obvious reason for assuming that the military duties of the engineer demand higher intelligence or more mental alertness

the army afforded opportunity for a study of the relation of intelligence to occupation. Various features of this relation are exhibited for a few military occupations by Fig. 12, in which are represented the proportions of the several grades of intelligence for the several occupations.

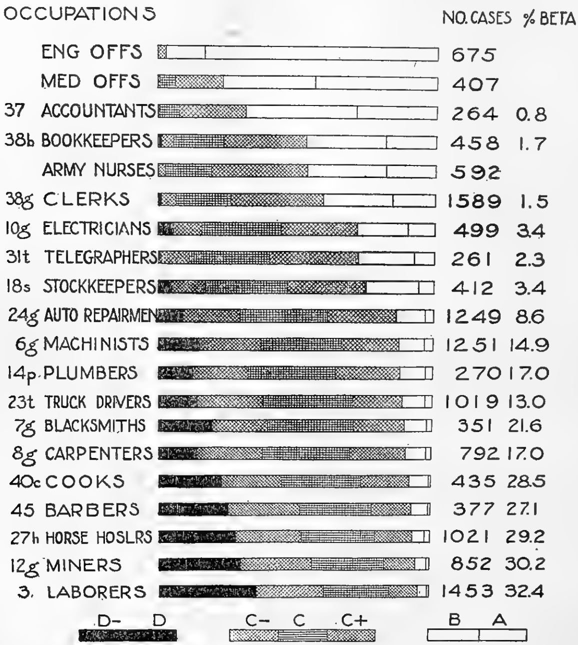

Fig. 12. Relation of occupation to intelligence.

than do those of the medical officer. Since it is improbable that any arm of the service possesses more intelligence than can be used to advantage, the necessary inference is that certain arms would benefit by the elimination of low grade men and the substitution of officers with better intellectual ability.

Relation of Intelligence to Occupation.—The occupational classification of soldiers in

In order of diminishing intelligence exhibited these groups may be classified as follows: professions, clerical occupations, trades, partially skilled labor and unskilled labor. The greatest differences in intelligence required or exhibited appear at the upper end of the scale, whereas the differences within the trades group are relatively small. The differences in range of intelligence occurring in the several occupations

are considerable and in all probability significant. In general the range diminishes from unskilled labor to intellectually difficult professions.

The data of this occupational study, which are merely sampled by Fig. 12, suggest both the possibility and desirability of preparing intelligence specifications for use in connection with civilian occupations. Such specifications, if satisfactorily prepared, should be useful alike as partial basis for educational advice and procedure and subsequently for vocational guidance. It must be emphasized in this connection that the data of Fig. 12 are not strictly comparable with such information as may be gathered concerning civilian groups because various selectional factors operate in the army.

The Applicability of Mental Measurements.—The utilization of methods of mental testing by the army has at once increased military efficiency by the improved utilization of brain power and demonstrated the applicability of the group method of measuring intelligence to educational and industrial needs. The army methods, although not adapted to the usual educational or industrial requirements, can readily be modified or used as a basis for the development of similar procedures.

There are abundant indications that the future will witness the rapid development of varied methods for improving scientific placement and vocational guidance. It is highly probable that grading in the public schools, in colleges and professional schools will shortly be based in part upon measurement of mental ability instead of exclusively on measurements of acquisition. The war has worked a miracle for what may properly be called mental engineering by precipitating expectations, surmises and desires which have long sought expression. Yesterday a few men believed in the probability of the early appearance and practical usefulness of this new branch of engineering; to-day scores of business men, educators and men of other scientific professions are convinced that it has arrived and demand its rapid and effective development.

The complete scientific report on the psychological data which the army has supplied and of which mere glimpses have been given in this article should constitute the basis for further important advances in methods of mental measurement and should greatly add to the knowledge of the distribution of intelligence and its varied and significant relations. These reports are in preparation and it is hoped that they may be published without undue delay.

SCIENTIFIC EVENTS

PROPOSED MAP OF BRAZIL ON THE SCALE OF ONE TO A MILLION

WE learn from the *Geographical Journal* that a further important advance in the mapping of South America is to be expected from the decision of the "Club de Engenharia" of Rio de Janeiro to celebrate the approaching centenary of Brazilian Independence (1922) by the compilation of a map of Brazil which shall also serve as a contribution to the scheme for a general map of the world on the scale of 1/1,000,000. We have received from Senhor Paulo de Frontin, President of the Engineering Club, copies of a memoir printed in 1916 describing the general features of the proposal (the execution of which has, it seems, already been begun) and the methods which it is proposed to adopt. It is pointed out that the great extension of the Republic renders it not feasible to construct a general map, capable of being combined into a whole even as a wall-map, on a larger scale than 1/2M (1:2,000,000), and that on the millionth scale the sheets would necessarily be used separately or combined with neighboring sheets only, Even on half this scale the conjoint map would measure 8 feet by 7½. The original compilation of the new map (the "Mother-map" as it is termed in the United States) will be on the

scale of 1/200,000, each sheet embracing one square degree, and including at least one point whose coordinates shall be fixed with satisfactory precision; for this the polyhedrical projection will be employed. In view of the enormous extent of the territory a complete new survey will be dispensed with, any trustworthy material already existing being employed and supplemented by reconnaissances and astronomical determinations of position. It is reckoned that about 8,000 kilom. have already been surveyed on the scale of 1/100,000, and that about 1,700,000 kilom., or one fifth of the total area of Brazil, have been mapped on other scales. To resurvey the whole on the 1/100,000 scale would, it is calculated, occupy 690 years, and the small state of Rio de Janeiro alone four years. But a map free from important errors and giving a good general representation of the country could be made in twenty-one years, or less if existing material is taken into account. Thus it is hoped that a satisfactory mapping of half the whole area may be completed in time for the Centenary celebration, the other half being left for the second century of independence.

SCIENTIFIC MEETING OF THE BRITISH MEDICAL ASSOCIATION

DURING the four years of the war, the scientific meetings of the British Medical Association were suspended and only the political meetings of the representatives were held. The last ordinary annual general meeting was held in July, 1914, and it had been arranged to hold the following meeting at Cambridge, under the presidency of Sir Clifford Allbutt. This meeting was abandoned, because of the strain on the profession owing to the war. The London correspondent of the *Journal* of the American Medical Association writes that it has been found impossible for Cambridge to arrange to receive the association this year, but it hopes to do so in 1920. It was therefore suggested that a special meeting might be arranged this year for the discussion of clinical and scientific subjects, but on a smaller scale than usual. At a meeting, the proposal was laid before Lieutenant General Sir John Goodwin, the director general of the army medical service, and representatives of the medical services of the British navy and air force and of the medical services of the Dominions and of the United States. In opening the proceedings, Sir Clifford Allbutt said that the time had come to relay old tracks and make plans for reconstruction, but that it had not been considered advisable to hold a full dress meeting this year. A short scientific meeting could be held this year in London without any attempt at large organization or elaborate entertaining. Dr. J. A. MacDonald, chairman of the council, said that the main object would be to bring together workers from at home, the Dominions and the United States to garner knowledge and ideas from those who had studied war medicine and surgery. Lieutenant General Sir John Goodwin thought that such a congress was most desirable. Much scientific work of the highest value had been done during the war, and the results were now being analyzed. It would be an immense advantage that they should be examined. All possible facilities would be given to assemble research workers from the forces overseas. Colonel A. M. Whaley, United States liaison medical officer with the War Office, welcomed the idea on behalf of the American medical officers serving in Europe. Approval was also expressed by representatives of the Canadian, Australian and New Zealand medical service. All agreed that the meeting would be valuable in crystallizing the knowledge gained during the war. In view of the approaching departure of many medical officers, it was felt that the meeting should be held as soon as possible. It was provisionally agreed that the meeting should be held early in April and should last two or three days.

PROPOSED MAGNETIC AND ALLIED OBSERVATIONS DURING THE TOTAL SOLAR ECLIPSE OF MAY 29, 1919

SPECIAL magnetic and allied observations will be made at certain stations inside and outside the shadow belt of the total solar eclipse of May 29, 1919, by the Department of

Terrestrial Magnetism of the Carnegie Institution of Washington, and by various magnetic observatories, institutions and individuals who have offered their cooperation. The stations of the Department of Terrestrial Magnetism will be probably: (1) La Paz, Bolivia; (2) Huancayo (north of belt of totality); (3) Near Sobral, Brazil; (4) Lle Principe or Libreville, French Congo; (5) Stations outside belt of totality by field parties as found possible. At station 3 complete magnetic and electric observations will be attempted.

The general scheme of work proposed by the Department of Terrestrial Magnetism is as follows:

1. Simultaneous magnetic observations of any or all of the elements according to the instruments at the observer's disposal, every minute from May 29, 1919, 9^h 58^m A.M. to 4^h 32^m P.M. Greenwich civil mean time, or from May 28, 21^h 58^m to 4^h 32^m May 29, Greenwich astronomical mean time.

(To insure the highest degree of accuracy, the observer should begin to work early enough to have everything in complete readiness in proper time. Past experience has shown it to be essential that the same observer make the readings throughout the entire interval. If possible, similar observations for the same interval of time as on May 29 should be taken on May 28 and 30, to afford some means of determining the undisturbed course of the magnetic declination.)

2. At magnetic observatories, all necessary precautions should be taken to insure that the self-recording instruments will be in good operation not only during the proposed interval but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. It is recommended that, in general the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base line.

3. Atmospheric-electric observations should be made to the extent possible with the observer's equipment and personnel at his disposal. At least observations of potential gradient and conductivity (preferably both positive and negative) should be made.

4. Meteorological observations in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that, at least, temperature be read every fifth minute (directly after the magnetic reading for that minute).

5. Observers in the belt of totality are requested to take the magnetic reading every thirty seconds during the interval, 10 minutes before and 10 minutes after the time of totality, and to read temperature also every thirty seconds, before the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal of *Terrestrial Magnetism and Atmospheric Electricity*. Those interested are referred to the results of the observations made during the solar eclipse of June 8, 1918, the publication of which was begun in the September, 1918, issue of the journal. A summary of the magnetic results obtained is given in the March, 1919 issue.

LOUIS A. BAUER

WASHINGTON, D. C.,

SCIENTIFIC NOTES AND NEWS

CHARLES LEANDER DOOLITTLE, Flower professor of astronomy, emeritus, at the University of Pennsylvania and director of the Flower Observatory, died on March 3, aged seventy-five years.

DR. WILLIAM WILLIAMS KEEN had conferred on him the honorary degree of Doctor of Laws by the University of Pennsylvania on University Day. In conferring the degree, Provost Smith paid the following tribute to Dr. Keen: William Williams Keen, voluminous writer on medical subjects, especially surgery, in which you have an international reputation; corresponding member of learned societies in England, Scotland, Belgium, France and Italy; honored at home and abroad by ancient univer-

sities with their highest degrees; author of meritorious historical documents; active participant in all social movements of an uplifting nature, sturdy patriot; only commissioned officer in the present war who was a commissioned officer during the Civil War; beloved teacher, honored citizen.

The same degree was conferred on Dr. Frederick Petersen, of whom Provost Smith said: Eminent psychiatrist, and author of profound works upon the most mysterious mental diseases; learned in medical jurisprudence and in toxicology; poet of distinction, to whom the literary world is also indebted for hidden gems from the Swedish and Chinese literature.

Major-General William C. Gorgas, formerly surgeon-general of the United States Army, has been named a commander of the French Legion of Honor.

Dr. Stephen Smith celebrated his ninety-sixth birthday on February 19. He is in good health and only resigned from his position on the New York State Board of Charities in February, 1918, after having served on the board for thirty-four years.

Colonel Sir Ronald Ross has been appointed consultant in malaria cases to the British Minister of Pensions. He will advise on these cases in addition to his duties as consultant in malaria to the War Office.

The Belgian Surgical Society, at its first meeting since July, 1914, elected Professor Depage as president.

Professor Julius Stieglitz, chairman of the department of chemistry at the university of Chicago, has been appointed chairman of the committee on publication of compendia of chemical literature for the American Chemical Society.

William Bowie, major of engineers, U. S. Army, was honorably discharged on February 28. He has resumed his duties at Washington, D. C., as Chief of the Division of Geodesy, U. S. Coast and Geodetic Survey.

H. F. Staley, formerly professor of ceramic engineering at Iowa State College, who had been engaged in war research at the Bureau of Standards since June, 1918, has joined the staff of the Bureau as metallurgical ceramist.

Colonel G. A. Burrell, of the Chemical Warfare Service, has returned to private chemical engineering work at Pittsburgh, Pa.

Mr. George W. Morey, of the geophysical laboratory of the Carnegie Institution of Washington, has been granted leave of absence for one year to take charge of the optical glass plant of the Spencer Lens Co., Hamburg, N. Y.

The Utah Agricultural Experiment Station has recently established a department of range management under the direction of Professor Raymond J. Becraft, formerly of the U. S. Forest Service. One of the first problems to be undertaken by the department will be to increase the carrying capacity of Utah ranges by scientific management.

Ed. L. Ayers, formerly chief nursery inspector in the Texas Department of Agriculture will become plant pathologist in the Extension Service to succeed Frederick A. Blodgett.

Professor John N. Van der Vries has resigned his position as professor of mathematics at the University of Kansas to continue work as secretary of the Central District of the Chamber of Commerce of the United States, 801 Otis Building, Chicago.

Mr. Frank A. Dickey, registrar of Columbia College, has resigned to become the business manager of the Rockefeller Institute of Medical Research.

Dr. William I. Dublin, statistician of the Metropolitan Life Insurance Company, has returned to the United States, from war service under the American Red Cross, in Italy, Greece and Serbia.

Dr. H. Gideon Wells, of the department of pathology at the University of Chicago, who is also director of the Atho S. A. Sprague Memorial Institute, recently left Constantinople as head of the American Red Cross Mission to Roumania with relief supplies for that country. Dr. Wells has already spent several months in Serbia and Roumania in connection with Red Cross medical work.

CAPTAIN LEO M. BEILIN, M. C., U. S. Army, of Springfield, Ill., started for Siberia, on February 15, where he is to be placed in charge of a unit to combat typhus.

DR. L. A. BAUER left Washington early in March for England, where he will organize an expedition for magnetic and electric observation during the solar eclipse of May 29, 1919 at a station in South Africa; he expects next to proceed to South America and arrange for similar observations during the eclipse there. His eclipse station will probably be La Paz, Bolivia. While in South America he will visit various institutions and return to Washington next July.

MR. HENRY WIGGLESWORTH, of the General Chemical Company, has accepted a commission for the Bureau of Foreign and Domestic Commerce to study the dyestuff and textile conditions in France.

PROFESSOR L. M. WINSOR, B.S., specialist in irrigation and drainage for the Utah Experiment Station in cooperation with the U. S. Department of Agriculture, who has been granted a leave of absence, recently left for South America to determine the possibilities of bringing a large tract of arid land under cultivation in Chile by irrigation. The land is controlled by the Guggenheim mining interests.

AT the meeting of the Baltimore City Medical Society, held in Osler Hall on February 21, Brig.-Gen. William S. Thayer, chief consultant of the medical division, and Major-Gen. John M. T. Finney, chief consultant of the surgical division, Medical Corps, United States Army, spoke on the work in France.

PROVOST EDGAR F. SMITH, of the University of Pennsylvania, delivered an address on "Early Mineralogists and Chemists" at the Academy of Natural Sciences, Philadelphia, on Tuesday evening, February 18.

THE sixth lecture of the series of The Harvey Society lectures will be by Dr. Yandell Henderson on "Physiology of the Aviator" at the New York Academy of Medicine on Saturday evening, March 29, at 8:30. The Harvey Lectures are open to the public.

LIEUTENANT COLONEL A. M. PATTERSON, professor of anatomy in the University of Liverpool, who has held the office of assistant inspector of military orthopedics for several years, has died at the age of fifty-six years.

M. COGGIA, assistant in the Marseilles Observatory for more than fifty years, died on January 15, at the age of seventy years.

THE work on volcanology at Kilauea has been placed under the U. S. Weather Bureau. The transfer was effective on February 15 and the appointment of the Director Professor T. A. Jaggar has been approved. An appropriation of $10,000 for the year is made by the government for continuing the work heretofore maintained by the volcano Research Association.

THE thirtieth session of the Biological Laboratory at Cold Spring Harbor, Long Island, will be held from June to September, 1919. Regular class work will be held for six weeks beginning July second. The courses of instruction include field zoology by Drs. Walter Kornhauser and Parshley; bird study by Mrs. Walter; comparative anatomy by Professor Pratt; animal bionomics by Dr. Davenport; systematic and field botany by Dr. John W. Harshberger and Mr. C. A. Stiteler; advanced botany by Dr. Harshberger; heredity by Professor Harold D. Fish and training course for field workers in eugenics by Drs. C. B. Davenport, H. H. Laughlin and Harris H. Wilder. Copies of the announcement may be obtained from the Biological Laboratory, Cold Spring Harbor, Long Island, N. Y.

UNIVERSITY AND EDUCATIONAL NEWS

DR. SAMUEL W. LAMBERT, professor of clinical medicine and dean of the College of Physicians and Surgeons, of Columbia University, has resigned.

MAJOR J. H. MATHEWS, Ordnance Dept., U. S. A., has been released from military service and has returned to the University of Wisconsin, where he has been promoted to a full professorship in charge of the courses in physical chemistry.

C. F. Curtis Riley, who has been special lecturer in animal behavior in the department of forest zoology, at the New York State College of Forestry, at Syracuse University, for the past year and a half, has been appointed assistant professor of forest zoology, in the same institution.

Dr. Luther C. Peter has been elected professor of ophthalmology in the graduate school of the University of Pennsylvania.

DISCUSSION AND CORRESPONDENCE

AN APPEAL FROM BELGIUM

The following letter has been received from the Curator of the Entomological Section of the Royal Museum of Natural History of Belgium:

[Translation]

Brussels, 11–1–1919.

Dear Sir:

It is absolutely necessary that you write some notices in the American scientific journals in order to save the Selys Catalogue. I have lost twenty subscriptions in Europe and I must retrieve them in the United States. Financial aid from the deSelys family is impossible for a long time. Each new subscription will bring a little capital to the reconstitution of this work which can be brought to a termination with a little energy and with the aid of all. The great institutions, libraries, etc., ought to put some of their pennies into subscriptions.

Here we have suffered much from the slow and inexorable hunger, from the nervous depression of our abominable slavery that no one can describe. Our museum and our collections are saved, but I have lost one of my two sons who was at the front, a fine boy of 24 years, a captain of engineers. I have lost a part of my small fortune and my health, but more I fear that the sufferings from hunger have compromised the future of my younger son and of my grandchildren.

The balance sheet is sad and I have little courage to take it up. I would not, however, see the Catalogue, to which I have devoted myself for years, founder. This is why I call for your aid. Write to your entomological friends and sustain me.

Yours sorrowfully,

G. Severin.

The Baron Edmond de Selys Longchamps (1813–1900) was known as the chief authority on the taxonomy and geographical distribution of the Odonata. He formed an extensive collection of these insects and of other "neuropteroids" from all parts of the world, and of the vertebrates and some other groups of Europe. These collections were presented after his death to the Brussels Museum by his two sons.

The publication of the "*Catalogue Systematique et Descriptif des Collections Zoologiques du Baron Edm. de Selys Longchamps,*" "designed to realize the supreme desire of their late possessor and at the same time to serve science," was begun in 1906 under the care of the two sons, M. Severin and a number of zoologists, who undertook, as specialists, the preparation of certain parts thereof.

It was planned to appear in 32 fascicules of a varying number of pages, of large quarto size, illustrated by text figures and some plates. The subscription price for the complete work was fixed at 25 centimes (20 centimes for the fascicules on Orthoptera, Lepidoptera and Vertebrata) per page of text, 2.75 francs per colored plate and 2 francs per black and white plate, with an increase of 25 per cent. for subscription to separate parts only.

At the beginning of the war 21 fascicules had appeared, treating of the Orthoptera, Embiidæ, Perlodides, Megaloptera, Trichoptera, Ascalaphidæ, Libellulinæ, Cordulinæ, Æschninæ, Birds, Mammals, Amphibia and Fishes, at a total price of 703.50 francs. The eight fascicules on the Libellulinæ by Dr. F. Ris, of Rheinau, Switzerland, constitute the most extensive monograph on that subfamily ever produced, and several other groups have been dealt within a similar fashion. Several fascicules are in such an advanced state of preparation or of printing that they can be issued in a short time.

There are many reasons—scientific, humanitarian, international, appreciative of the nation which has suffered so fearfully—why the Selysian catalogue should be carried to completion and it is to be hoped that readers of this appeal will personally do all in their

power to aid in this accomplishment by inducing institutions which they can influence to subscribe. All correspondence relating to subscriptions should be addressed to M. G. Severin, Musée Royal d'Histoire Naturelle, 31 Rue Vautier, Bruxelles, Belgium.

PHILIP P. CALVERT

UNIVERSITY OF PENNSYLVANIA

CROSS-SECTION LINES ON BLACKBOARDS AND THEIR ILLUMINATION

THOSE who wish cross-section rulings on blackboards temporarily, thus leaving the board free for other work after the curve-plotting is finished, can do so by a simple device. On a sheet of white paper make a ruling of lines, 2 cm. apart, the whole grid being 16×24 cm., and the lines not quite one mm. thick. Take a photograph of this, making the camera image the size of a lantern-slide. Mount the negative in a lantern, projecting the image on the blackboard. A lantern equipped with a 400-watt Mazda lamp will make the lines sufficiently visible for plotting even in a well-lighted room. The lines are erased by turning off the lamp.

FLOOD-LIGHTING FOR BLACKBOARDS

A SIMPLE system of lights should be added in dark recitation and lecture rooms, so that no light reaches the eye, either from the illuminant, nor from the board by direct reflection. A 40-watt lamp suffices for 4 ft. of blackboard, and need not project from the wall more than 18 inches.

PAUL F. GAEHR

WELLS COLLEGE

CONCERNING THE MANUFACTURE OF SULPHONIC ACIDS

THE Department of Agriculture announces that the color laboratory of the Bureau of Chemistry, of this department, has developed, on a laboratory scale, a new process for the manufacture of certain sulphonic acids. This process, as carried out in the laboratories, appears so promising that it is thought that some manufacturers of chemicals and dyestuffs in this country may be able to supply their demands for these and other valuable compounds by this process, provided the process can be reproduced upon a technical scale so as to obtain results commensurate with laboratory investigations. The process refers particularly to the sulphonation in the vapor phase of benzene, naphthalene, and other hydrocarbons.

With a view to helping the chemical industry of this country, the Department of Agriculture hereby announces that it is ready to assist manufacturers who wish to produce these compounds. The expenses of the technical installation and of the labor and materials necessary will of necessity be borne by the firm, individual, or corporation wishing to manufacture the products. The chemists of the Color Laboratory will assist with expert advice, etc. The department reserves the right to publish all the data obtained from the technical experiments.

This offer of assistance will not be held open by the department for an indefinite period.

D. F. HOUSTON,
Secretary

DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

SCIENTIFIC BOOKS

British Antarctic (Terra Nova) Expedition, 1910. Natural History Report, Zoology, II., No. 8. *Brachiopoda.* By J. WILFRID JACKSON, F.G.S. 4to, pp. 177–202, 1 pl., July 27, 1918, London, British Museum.

The various Antarctic expeditions in the years immediately preceding the war, obtained material greatly extending our knowledge of the fauna of the regions about the Southern Pole. This to a considerable extent reached the scientific world by means of publication, but a certain portion was delayed and, owing to war conditions, seemed likely indefinitely to continue so. It is therefore with peculiar pleasure that we have received the present contribution issued during the past summer by the trustees of the British Museum.

The Brachiopoda obtained by the Terra Nova party form an interesting and valuable series adding considerably to our knowledge of the characteristics and geographical distribution of the Antarctic species. One of the forms

collected seems to show differences from its Rhynchonellid relatives which have induced the author to propose for it a new genus *Compsothyris,* though no new species were obtained. The paper is illustrated by an excellent plate and has a bibliography of the more important literature.

Australasian Antarctic Expedition, 1911–14, Scientific Reports, Series C.—Zoology and Botany, Vol. BI., pt. 1, 4to. "Calcareous Sponges," by Professor Arthur Dendy, pp. 1–17, 1 pl.; Vol. III., pt. 2. "Pterobranchia," by W. G. Ridewood; 26 pp., 1. pl.; Vol. V., pt. 5, "Euphausiacea and Mysidacea," by W. M. Tattersall; 16 pp. and 1 pl.; Vol. IV., pt. 3. "Brachiopoda," by J. Allen Thomson, pp. 76, and 4 pl.; Vol. V., pt. 6, "Cumacea and Phyllocarida," by W. T. Calman, pp. 12 and 1 pl. Sydney, N. S. W. Government Printing Office, 1918.

The continued publication of these purely scientific papers before the cessation of active military operations and in despite of financial stresses, reflects credit upon the government of Australia. The citizens of that commonwealth have naturally taken great pride in the success of their expedition and its valuable results for science, and these handsomely published memoirs are an expression in part of that pride.

The number of calcareous sponges from the Antarctic is small, but to them are added a number collected off Tasmania and at Macquarie Island. The collection includes two new species of *Leucetta* and one of *Leucandra.*

Dr. Ridewood's memoir contains no new species but forms a useful review of the austral species of *Cephalodiscus* with a bibliography of the rather scanty literature.

Dr. Tattersall treats of four species of Euphausians and two of Myacids, one of the latter from the Auckland Islands being new is described as *Tenagomysis tenuipes.* Dr. Calman describes a new species of *Diastylis* and reviews forms of *Nebalia* and *Cyclaspis,* which fill a wide gap in our knowledge of their geographical distribution. Dr. Thomson's memoir on the *Brachiopoda* is of particular importance, comprising a review of the group in the southern hemisphere, the description of new forms, and an interesting discussion of the relations of the existing forms to their fossil precursors and their distribution in connection with theories of previous land connections between the different continents in earlier geological time. His conclusion is that the present distribution lends probability to the hypotheses of von Ihering and others which assume such linking up of the various bodies of land in the later Mesozoic epoch. The paper has an excellent bibliography, but it is to be regretted that the phototyped figures in many cases are insufficiently clear to show the details mentioned in the text.

W. H. Dall

SPECIAL ARTICLES

ROTARY VERTIGO IN THE TAIL-SPIN

In the tail-spin, an evolution that is standard among military and exhibition aviators and into which any flier is apt to fall accidentally, a marked rotary and post-rotary vertigo may be induced. As the maintenance of the correct flying attitude of the airplane is largely dependent upon the pilot, this disturbance in his idea of attitude may lead to serious consequences and its significance and characteristics merit definition. A true appreciation of the phenomenon should increase the confidence of the young pilot just becoming acquainted with the evolution and decrease the risk attached to this feature of aviation training.

Purkinje in 1820 (quoted from McKendrick[1]) directed attention to the well-known vertigo of rotation. In brief, *when the movement of the body is arrested after undergoing rotation—*

(1) *an after-sensation of rotation in the same direction is experienced.* In coming out of the spin and levelling off, the pilot experiences a sensation of rotation after that has actually ceased. He therefore, tends to overcontrol, with the consequent danger of falling into another spin in the opposite direction.

(2) *The axis of this imaginary after-sensation of rotation is that axis of the head about*

[1] Schäfer's "Text-Book of Physiology," 1900, II., p. 1196.

which the actual rotation took place. This suggests a precaution—during the spin, hold the head down so that it is rotated about its long axis; on coming out of the spin, raise the head. Any disturbance experienced then will be in directional (*i. e.,* horizontal) stability, and the more dangerous falling reaction will be avoided.

The superior reliability of visual criteria of attitude should be recognized. "Follow the horizon, if it ties itself up in a knot," is a good rule to remember.

A very illuminating incident that occurred at Mineola when the writer was stationed there, first suggested this analysis of the rôle the rotary vertigo may play in the tail-spin. On June 29, 1918, a pilot, while flying in a formation, lost his balance and fell off into a tail-spin. He got out of the spin, but fell off into another spin *in the opposite direction.* And he got out of the second spin also, but only to fall into a third, *again reversing.* He crashed and was seriously injured.

The pilot in question was acquainted with the tail-spin, but had never done one "solo" before. It immediately occurred to the writer that the accident was a case of overcontrol due to a falling reaction and the precaution under (2) suggested itself. At the same time it was recalled that Lieutenant Simon,[2] instructor in acrobatics at the school at Pau, France, cautioned his pupils to hold the head down under the cowl during a spin. Evidently the French aviator had arrived empirically at the same rule that the writer had deduced from his acquaintance with a physiological phenomenon. No knowledge of the precaution has been met with among American trainers.

The observations were at the time (July, 1918) informally brought to the attention of several members of the staff of the Medical Research Laboratory at the field. Subsequent observations and experiences as a pilot in acrobatic flying have confirmed the conclusions.

M. A. RAINES

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[2] Quoted from Nordhoff in the Atlantic Monthly for April, 1918.

THE GALTON SOCIETY FOR THE STUDY OF THE ORIGIN AND EVOLUTION OF MAN

THE objects of the society are the promotion of study of racial anthropology, and of the origin, migration, physical and mental characters, crossing and evolution of human races, living and extinct.

The charter members of the society are as follows: Madison Grant, Henry Fairfield Osborn, John C. Merriam, Edward L. Thorndike, William K. Gregory, Charles B. Davenport, George S. Huntington, J. Howard McGregor, Edwin G. Conklin.

The organization of the society was suggested and initiated by Messrs. Davenport and Grant on March 6, 1918. On April 2, after several previous conferences, Messrs. Davenport, Grant, Osborn and Huntington adopted the charter and the name of the society. The first meeting of the charter fellows was held in New York on April 7 at the residence of Professor Osborn, who outlined the object of the society and emphasized the importance of a union of effort on the part of specialists, working in close cooperation and harmony with one another but from widely diverse lines of approach. Professor C. B. Davenport was elected chairman and Dr. W. K. Gregory secretary. The following men were elected as fellows: Drs. Ernest A. Hooton, Peabody Museum; Gerrit Smith Miller, United States National Museum; Raymond Pearl, United States Food Administration; L. R. Sullivan, American Museum of National History; Frederick Tilney, New York; Professor Harris H. Wilder, Smith College; Dr. Clark Wissler, American Museum of Natural History. Two patrons were elected: Mrs. E. H. Harriman and Mr. M. Taylor Pyne, New York.

A meeting of the society was held in the Osborn Library at the American Museum of Natural History on May 14. At this meeting Professor McGregor demonstrated his reconstruction of the skull of a typical adult Crô-Magnon man, based on all known remains of the race.

Dr. Wissler sketched the rise of anthropology in Europe and America, and contrasted the two concepts of this study: the first as including all lines of investigation on the origin and evolution of human races and of their cultures, and the second as limiting anthropology to the study of physical characteristics. He said that the museum had tried to develop all branches of anthropology in the broader sense, and referred to the methods of exhibiting these lines which were to be illustrated by Mr. Sullivan's paper.

Mr. Sullivan, in giving an account of a museum exhibit of the races of the Philippine Islands, based on a critical examination of the literature, showed that at least three physical types are present there, characterized by differences in skin-color, hair, stature, head-form and form of nose; first, the negritos, long recognized as a distinct race, who are short in stature, with a very dark brown skin, wide open dark brown eyes, black kinky hair, short head and short wide nose; second, the Malayan tribes, tallest of the island groups, with skins of varying shades of brown, dark brown Mongoloid eyes, straight black hair, and relatively narrow nose; and third, a group which is often confused with the second but belongs to the Indonesian racial type. This type stands between the negritos and Malays in point of size, is less Mongoloid in appearance, has the longest head on the islands, and straight or wavy dark brown hair. Mr. Sullivan's paper was discussed by Professor Kroeber who outlined the successive cultural strata in the Philippines.

Professor Davenport, the chairman of the society, commented on the wide field for the labors of such an organization which was afforded by the presence in New York of representatives of many of the living races of Europe, Asia and Africa, and by the existence of various organizations which would gladly cooperate in the study of the races of Europe. He spoke of the vast material at hand for the study of human inheritance and hybridization.

The second regular meeting of the society was held at the American Museum of Natural History on December 6, 1918. The meeting was preceded by a luncheon at which the members present were the guests of Professor Osborn and Mr. Grant.

Mr. Grant presented to the society a portrait of Sir Francis Galton. Professor Merriam spoke of the place anthropology should hold in the universities. In order to make the discussion concrete, he gave a brief outline of the history of anthropology in the University of California. When the department was started everyone thought best to begin with the local anthropological problem, in other words, with the study of the California Indians. Under Professor Kroeber this work has been carried to a very satisfactory conclusion and while a great deal more work should be done it seems that a point had been reached where new problems should be undertaken. The speaker thought this was typical of anthropology in America. Everywhere the feeling had been and rightly, that attention should be given to the problems at hand. The result is that we have a very systematic body of knowledge concerning the North American Indians, but have no contributing workers in larger anthropological problems. The effect of the world war and its broadening influences makes it highly desirable that anthropology should be put upon a broader and more fundamental plane, particularly should it deal with problems concerning our racial and national antecedents. The broadening of anthropology would also require the drawing in and coordination of much that has been done in psychology, biology, neurology and history. It was the hope of the speaker that the Galton Society would be able to bring about such coordination by bringing together some of the representative workers in respective lines. One of the first movements in this direction should be the encouragement of strong departments in our universities. Unless the universities can be induced to finance strong departments of anthropology we can not expect very great development in the future. On the other hand, it was the belief of the speaker that the universities would finance such departments of anthropology if they could see that the problems of anthropology were of universal concern.

There was a brief discussion by Professor Huntington, Mr. Grant and Professor Osborn.

Professor Huntington spoke of the four fields in which the differential characteristics separating man from lower mammals were particularly conspicuous, marking the progress of human evolution. These four fields were: the organs of locomotion, the hands, the vocal and respiratory organs and the central nervous system. It is in these fields especially that characters diagnostic of the various races are to be sought.

W. K. GREGORY,
Secretary

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BOTANICAL PARTICIPATION IN WAR WORK[1]

From the subject assigned me in this symposium, which, by the way, was before the armistice was signed, one naturally would suppose that what was expected was a catalogue of the achievements of botany during the war. From the amount of time allotted for this effort it becomes equally obvious that no such thing is possible. I therefore find myself in the delightful position of being free to disregard the subject (for no one can disregard the time limit) and shall discuss some aspects of the way in which botany may be regarded as having accomplished its full share in the world struggle, as well as attempt to point out the overwhelming importance of a recognition of the place the subject should occupy in any peace plan. This I shall hope to do without encroaching unduly upon the subjects assigned to those in this or other symposiums which have been announced, although I am inclined to think that at this time there cannot be too great a reiteration of the fundamental facts calculated to impress the public at large with some of the reasons which justify the existence of the science of botany.

Of course, one might attempt to point out the achievements of botanists, who, because of their special interests or training, have been of invaluable assistance in suggesting various botanical raw materials for which the commercial man was seeking, or in obtaining the right kind of sphagnum for surgical dressings, or their part in the work of the Bureau of Air Craft Production or the Sanitary Corps or in the perfection of the gas mask and similar strictly war work. Then if one were permitted to dwell upon the far-reaching effect of the agricultural application of botanical investi-

[1] Read at the Symposium of Section G, American Association for the Advancement of Science, Baltimore, December 26, 1918.

gations, not forgetting the activities of the plant pathologist, there would be no difficulty whatsoever in making a case for botany of which none of us need be ashamed.

The botanists of the world apparently left it to the Germans to devise the ultimate way in which a knowledge of plants could be adapted for purposes of war. At least the following incident given by a war correspondent, which appeared in print but not vouched for by me, may be accepted as an illustration of a method of applying taxonomy, which, to say the least, is capable of wide use. A man in a German uniform was brought into a German camp, suspected of being a spy. He claimed to have come from a certain part of the front and to be the bearer of an important verbal message concerning the movements of troops, the ordinary methods of communication having been shot away. Immediately the camp algologist was summoned and samples of mud from the boots of the prisoner as well as dirt from his finger nails were examined microscopically. The botanist reported finding *Conferva utriculosa* Kurtzing or *Tribonema utriculosum* Hazen, according to the nomenclatorial code approved by the General Staff, together with certain blue-greens and diatoms which constituted a characteristic flora of a region quite different from that from which the prisoner claimed to have come. In fact, by consulting the charts prepared by botanists for this purpose it was possible to indicate that the man had been in Russia. Confronted with this overwhelming evidence the victim of applied botany confessed that he was a Russian spy and was shot at sunrise.

The rôle that the ecologist might play in connection with camouflage and the aeroplane service was suggested at the meeting a year ago and need not be amplified here, although the temptation to do so is great. But with the close of the war, which obviously was not expected at the time this symposium was arranged for, such things considered from the standpoint of military effectiveness seem more or less out of date and we need to turn to more vital matters.

For the past four years and more, science has been subservient to war needs. The importance of any investigation has been distorted and magnified. A trivial piece of work conceived and finished in a week might be more useful in waging war than a lifetime spent in producing fundamental results which have no military value. Thank God, however, we are not always at war.

It is likewise well to bear in mind that one should be cautious in citing too freely, as has been common in the past, the supposedly favorable attitude which Germany has held for all things scientific. May it not be that this tendency held up as a model for all the world and manifesting itself in most substantial subsidations, was merely another form of propaganda, or at least primarily for the purpose of receiving every possible aid from every science which could contribute in the slightest way to building up a perfect war machine? In view of all that has transpired one is justified in questioning whether the underlying idea of the Teutonic mind was not science for science's sake—but science for war's sake.

When the Botanical Committee of the National Research Council was first formed it was apparently expected by some that this aggregation of botanical lights would assemble and after solemnly mentalizing on the whole situation would announce some discovery which would illuminate the world and win the war. Nothing could have been more absurd. So far as I know the only two suggestions which were made along the line of using botanical weapons for the direct destruction of life were rejected because they savored too much of Teutonic barbarity. Naturally the chief function of this or any other botanical committee could only be to have referred to it military problems requiring a knowledge of plants and their possibilities, in order that the most rapid and satisfactory solution be reached. That this was not always done until much valuable time was lost was not the fault of the botanists concerned, although it may have been the result of the general attitude of botanists, who, since they were freed from the demands made by *materia medica*, have regarded the birth of any botanical idea of prac-

tical importance as illegitimate, to be turned out into the cold to perish. These foundlings, however, were not infrequently rescued by some more enterprising member of a sister science and occasionally grew into most flourishing children of their foster parent.

Again we are all familiar with the fact that many of the most practical aspects of botany have grown to be of so much importance that they now assume the place of independent sciences, and are no longer recognized as having any connection with their mother science. In fact botany unadorned now stands in the minds of most people—including many scientists—as a synonym for the impracticable and the useless. The minute it becomes of value to man, either in peace or war, it must be called bacteriology or forestry or phytopathology. As a result of this wide-spread opinion we have a much-advertised achievement of another research council committee depending not only upon plants for the source of the product but also upon the application of botanical methods for the actual process of manufacture, yet with no reference whatsoever to botany. Another similar case is the recent establishment of a concern at present turning out more than seven tons a day of a product used in munitions, derived from corn. Although called chemical distillation, the process is one of fermentation, produced from pure cultures of an organism which is manipulated according to the practises devised in botanical laboratories.

Examples might be multiplied indefinitely of those who, working in other sciences, ask: "Can you tell me of a plant containing a certain kind of substance, where it grows, what is its name, whether it can be obtained in large quantities, and how to distinguish it from related plants? If so I can use the information in the solution of a problem upon which I am engaged." And after the questions are answered there appears an article based almost entirely upon the results of botanical investigations, for which the science chiefly concerned receives no credit whatsoever. This is no imaginary case. All botanists have had at least a few such experiences and were there time I might quote from letters received during the past year which would emphasize even more strongly this aspect of giving no credit where it is due.

It is probably true that botanists themselves are largely to blame for such a condition of affairs. Whether it be modesty or lack of interest or a failure to realize the importance of asserting themselves and emphasizing various aspects of science, the fact is self evident that altogether too much time in the past has been spent in criticism of others rather than attempting to correct their own faults. Perhaps we need a criterion by which botanical work may be definitely distinguished. We are obviously at a disadvantage in being confined to but one kingdom, while the chemist and physicist know no such limitations. But the plant kingdom certainly affords a reasonably wide field of endeavor, and presumably botanists are those concerned with plants—even plant physiologists. We calmly sit by and see aspects of our subject, which, according to present-day standards, make a thing worth while, appropriated for the benefit of other sciences because it is too much trouble or it is nobody's particular business to attend to such things.

Even the very name botany is avoided under the slightest pretext. New titles for branches of this science, usually with the prefix "chemical," are coined so fast that one can hardly keep up with them, and if to-morrow the cause of influenza or any human disease were proven to be due to a species of *Laboulbenia* or *Thelephora*, Dr. Thaxter or Dr. Burt, although at once taking first rank as applied botanists, possibly, much against their will, would over night lose all association with botanical science and become at the very least a Laboulbeniaceæologist or a Thelephoraceæologist. It may be too late to correct much of this sort of thing which already exists or to hope for a bureau in the Department of Agriculture that bears the name of botany, but why allow it to continue without a protest and taking steps to prevent similar efforts to smother our science in a multitude of misleading and detrimental names? If a man spends nine tenths

of his time working with plants why not call him a botanist, instead of—to take at random one of the most recent titles which has come to my notice—"assistant in horticultural chemistry and bacteriology?"

One difficulty in the past has been that the commercial man and the botanist have been too far apart. The war has helped to correct this situation, but much remains to be achieved. A few years ago there was published in the *Missouri Botanical Garden Bulletin* a short popular article by Dr. von Schrenk on "The lightest known wood—half the weight of cork." Because anything that is the lightest or biggest or most expensive in the world will gain the attention of the press, the article was widely reprinted. Consequently the Garden was besieged, by manufacturers in this country and abroad for information as to where the wood could be obtained. One might have supposed that the business man had exhausted every effort in an attempt to obtain such a product. As a direct result of the article there now exists in New York City the American Balsa Wood Corporation which does a large business in supplying this wood to those who need it. The botanist had had the information for years, but there was no adequate means of bringing it to the attention of those most concerned. Of course, had the account appeared under the title of "*Ochroma Lagopus*" the probability is that the industry in this wood would still be undeveloped, for the fact remains that botanists have been entirely too remiss in making known to the technical man the practical worth of his science. Much more important examples might be given, but I will refer to but one other experience in order to illustrate another phase of the matter.

Soon after the war broke out, one of the largest mail-order houses in the country sent to the Garden three umbrella handles for the purpose of having the wood identified. It being no longer possible to import these handles, the concern wished to see whether the word could be obtained in this country in order to have them manufactured here. When I tell you that one of the handles proved to be osage orange you will recognize that there was no great difficulty on this score. The point I wish to make is that had it been three chemicals or three ores to be examined and sources from which they could be obtained indicated, much would undoubtedly have been made—and rightly so—of the ability of the science concerned to help the commercial man. But because only a knowledge of botany was needed no publicity or no credit for the work was expected. Hundreds and possibly thousands of determinations of plants by botanists have been made since the outbreak of the war for the purpose of giving the manufacturer definite knowledge of the source and value of fibers, drugs, condiments, gums and other useful plant products. Some most fundamental and far-reaching results have thus been realized, but the standing of the botanist as a benefactor of mankind has been little if any changed. Perhaps if we returned to the old term of "plant analyst" and charged at the same rate a chemist would for making an analysis of an unknown, it might help to rehabilitate the botanist in the eyes of the business man. At any rate some means of obtaining the recognition due to the science concerned should be devised before all the work and benefit accomplished is forgotten. Similar instances from other lines of botany occur to all of you. Are we to continue along the same old path for the want of a definite plan calculated to improve the situation? I hope not.

But before I refer to this aspect of the subject, I wish to hasten to point out that all I have said must not be regarded as implying that the only aim of botanical science is to be of direct practical application. On the contrary, I would regard it as the greatest catastrophe which could befall botany and calculated to place it in a much worse position than it is—to neglect what is sometimes called pure botany or research. Still further, I am in hearty agreement with an opinion recently expressed in Science that it is a grave mistake to attempt to justify research by claiming that it may possibly lead to some practical result. "Research for research's

sake" is a motto which might well be posted in every botanical laboratory, and I believe we would all be the gainer by following such a precept. I have no patience with a worker who oscillates to and fro in an effort to include both pure and applied science in one single investigation. It reminds one of the correspondent who wrote to Harvey and described *Oscillatoria* as "fluttering back and forth on the borderland of the plant and animal kingdom." While some of us would like to think that a bit of our botanical research might be of practical importance, we can not hope to gain either one thing or the other by any deliberate effort to make an investigation pay for itself by any commercial standard. That abstract research sometimes brings concrete returns is true, but it generally requires a second part to make the practical application. When Naegeli wrote "On Oligodynamic Phenomena in Living Cells" he had no idea of solving the problem of a cure for certain bad odors and tastes in water supplies, although the necessity for a remedy for such conditions existed then as well as when the application of his work was made. Nor was it probable that any representation of a certain large corporation ever read Clark's paper "On the Toxic Effect of Deleterious Agents on the Germination and Development of Certain Filamentous Fungi," although the application of this research was the means of saving thousands of dollars and helping out a situation, which, because of the war, promised to be disastrous. It is an admission of weakness which no true student should grant for an instant—that *cui bono* must be the test of all botanical research.

Of course, when I refer to research I mean something worthy of the name. Perhaps there is no one thing about which so many harbor a delusion as that mystic form of scientific endeavor which is supposed to lift one above the common herd and land him in the very bosom of the scientists' heaven, namely research. It is sometimes referred to by the neophyte as "having a problem." Heaven knows, we all have problems enough—most of them very unscientific—but if they were no more real than the subjects for investigation of some of our scientists they would give us little concern.

Let us take an example: Suppose the Department of Scientific Restauranting in one of our large institutions of learning assigns to one of its graduate students the research problem of how many ham sandwiches may be obtained from a hog. Or if the president has not succeeded in shaving enough off of existing departments to add this important branch to his curriculum, the department of domestic science, or zoology, or, since the hog is normally vegetarian, the botanical department might undertake the investigation. In the first place it would be necessary to decide upon the standard size and weight of the ham to be ensandwiched. This would probably necessitate the granting of a traveling fellowship readily obtained from the representatives of one of the large packing houses in order that restaurants throughout the world might be visited and first-hand information obtained on which to standardize the slice of ham. Returning to the laboratory after perhaps a year's travel, the investigator would have accumulated innumerable bottles containing various samples properly preserved in alcohol or formalin and duly labeled with date and place of collection and such other environmental information as seemed necessary. It would then devolve upon the scientist to weigh and measure and plot curves until he had definitely decided upon the amount of ham which should be the basis of his investigation. This determined, he would then be free to turn his attention to the hog. I will not weary you with the details of the laborious and erudite investigation necessary to determine the amount of pure ham, suitable for sandwiches, which may be obtained from this animal. Of course, the easiest way would be to kill the hog, cook him and make him into sandwiches, but this would not be research as it is often practised—besides any one could do that and there would be no chance for scientific investigation. Nor need I dwell upon the discouragements and disappointments which the ardent seeker after truth would meet before the conditions of his problem were met.

A sudden fluctuation in the weight of the hog might upset all his calculations and the final answer be obtained only in time to hand in his thesis at the twelfth hour. After graduation there remains, of course, the investigation of the size, shape, consistency, etc., of the bread used in ham sandwich-making, whether rolls are permissible or not, the origin and history of the use of mustard, until at last, after years of labor, the most complete, the most exhaustive and the most learned monograph on the ham sandwich is given to the world, and the author is hailed as one of its leading scientists. He may then devote himself to the monographing of other sandwiches, finally becoming the world's authority on this group, having specimens sent for identification from every railroad station in every sandwich island and continent of the civilized world.

Absurd as the foregoing may seem, you all know that actual examples of so-called research work might be cited which would be not a whit more sensible. A serious examination of the countless papers published in any one of the sciences will reveal an appalling number of trivial, inconclusive, unscientific effusions, at the most mere petty records of hypotheses and haphazard observations, which far from being contributions to knowledge, are but a means of disclosing the ignorance of their authors of the first principles of science.

That such work should be bolstered up by the claim that possibly it might be turned to some practical application, is calculated to bring all research, good or bad, into disrepute. I do not believe that any member of a board of trustees or a prospective philanthropist is fooled by the attempt to justify herbaria or libraries or laboratories solely on the grounds of definite, practical usefulness to mankind in general. If botanical research is not of enough importance to sustain itself regardless of any incidental benefit that may arise through it, the greater portion of it would better be dispensed with in order that the time and effort and money now wasted be turned to something capable of standing on its merits.

It is to be hoped that either through the perpetuation of the Research Council, or better, through some committee representing all botanical interests, there may be an organized attempt to raise the general standard of research work in botany at least. But why stop here? Is it not time that botanists recognize in a tangible way their obligation to the public at large, and that we see to it that our profession takes a worthy part in the world work of the future? Perhaps it has in the past. If so, it behooves us more than ever to stand firmly for our rights and the recognition due us. In spite of the shudder that may pass over some of you present I venture to suggest that a committee of the Botanical Society of America on publicity might not be out of place. Other sciences which apparently need it less, have not hesitated to adopt such modern methods. There might also be added a committee on botanical raw materials, with sub-committees on economic or applied phases of certain special topics, or, if it seemed best, a general development committee which would deal with botanical ideals and ideas in a way calculated to crystallize the more essential activities of the science and make more tangible the benefits and achievements resulting from a fundamental knowledge of plants. Surely the need for something of this kind is quite as great as the object of committees already in existence. Perhaps too much attention can not be paid to the details of the multitudinous ramifications which sprang from the parent trunk, but we cannot afford, either for our individual or professional good, to neglect the subject as a whole. No time could be more propitious for accenting the place which botany holds. It may have been a "chemical war" which the world has suffered. I for one am perfectly willing to let it go at that. But should we not do something definite towards making it a botanical peace upon which we are about to enter?

George T. Moore
Missouri Botanical Garden

SAMUEL WENDELL WILLISTON[1]

Samuel Wendell Williston, our distinguished senior colleague in vertebrate paleon-

[1] Based on the author's article in *The Journal of Geology*, November–December, 1918.

tology, passed away August 30, 1918, honored and beloved by all who knew him. Our admiration for his character and achievements is enhanced through a perusal of his personal recollections[2] of his career, which reveal long struggles towards scientific attainment, lofty ideals of exploration and research, and an unfaltering determination.

Like all men of science who have risen to distinction, Williston was self-made, the impulses all coming from within; yet he was instinctively alert to seize every chance to learn and to expand his horizon. We can not imagine a life story more helpful than his to the youth predisposed to science who has both to discover his own talent and to explore every avenue of opportunity which presents itself.

Williston was born in Roxbury, now a part of Boston, July 10, 1852. He writes:

> The Williston family has been traced back to about 1650 in Massachusetts; they were about the usual run of common people, no one famous or even noted, whether for good or evil. . . . Some of them served in the War of the Revolution, and many were fishermen.

His father was born in Maine, and he remarks of this branch of the family:

> They knew little of schools. My father, if he ever went to school, did not take kindly to study, for he never learned to read or write. . . . It was a great pity, too, for my father was a man of far more than ordinary ability as a mechanic—he was noted always for his skill. . . . Of all his children I resemble him the most, both physically and mentally.

His mother was from England, having come with her parents to New Jersey about 1812. She had a fair common-school education, and the effects of her early English training and her accent remained through life.

The intellectual and social environment of Roxbury probably never would have produced a geologist or a paleontologist, and while the next step in Williston's life was hard, yet it was propitious, as the events proved:

> In the spring of 1857 my parents decided to emigrate to Kansas. A colony had left the year before for Manhattan, and the letters that came back had infected many with the desire to go West. . . . The abolitionists were urging eastern people to colonize the territory in order to help John Brown preserve it to the "Free States." . . . The trip was long and tedious, by rail to St. Louis, then a small place, and thence by steamboat up the Missouri River to Leavenworth. There was no Kansas City then. We reached Leavenworth about the twentieth of May. Here we remained a few days in a very small hotel, while my father bought a yoke of oxen and a wagon and such provisions and household things as were indispensable, and we started on the slow and tedious drive of 115 miles to Manhattan through a country but very sparsely settled. For the most part we children rode in the covered wagon while my father and cousin walked and drove the oxen.

The first building erected in the new town was the stone school-house, to which books were supplied by the Emigrant Aid Society. At the age of seven young Williston made his first collection of fossil shells, from deposits since determined as belonging to the Lower Permian. Following school, he entered the State Agricultural College in 1866. At the age of fifteen he came under the rare influence of Professor Benjamin F. Mudge, who loaned him a copy of Lyell's "Antiquity of Man." Mudge conducted all the courses in natural history, and through his splendid character and example exerted a great influence on young Williston. It was quite by accident, however, that seven years later Williston was included in Professor Mudge's party to northwestern Kansas (Smoky Hill Valley Cretaceous) where Professor Mudge, already famous through his discovery in 1872 of a specimen of *Ichthyornis,* was collecting.

Vertebrate paleontology had become his first love, but he had leanings towards human anatomy and medicine and entomology, first as an avocation and then as a vocation. He was afforded no independent opportunities for paleontological research and publication by Professor Marsh, by whom he was invited to come to New Haven in February, 1876. In the summer seasons of 1876 and 1877 he col-

[2] See "Recollections," an unpublished autobiography, written May, 1916, copyrighted by Mrs. S. W. Williston.

lected with Professor Mudge in the Cretaceous chalk of Kansas. In 1877 he was sent by Professor Marsh to the Morrison, Canyon City and Como quarries to cooperate with Professors Lakes and Mudge and Mr. Reed in taking out the types of *Atlantosaurus, Diplodocus* and other sauropods. In Professor Marsh's laboratory Williston worked on the dinosaurs. In the field in 1878 he helped to collect the "Jurassic Mammals" and some of the smaller dinosaurs. For nine years (1876–85) he worked in Professor Marsh's laboratory, where he became closely associated with Marsh's other assistants, especially Harger and Baur.

While acting as assistant in paleontology he studied medicine at Yale, received the degree of M.D. in 1880, continued his postgraduate studies, and received the degree of Ph.D. at Yale in 1885. He then became demonstrator of anatomy (1885–86) and professor of anatomy (1886–90) at Yale and practised medicine in New Haven, where he was health officer in 1888–90. In 1886 he published some criticisms of Koken's work on *Ornithocheirus hilsensis* which give us some hint of his abiding interest in Kansas fossil reptiles, an interest which was soon to bring great results.

The turning-point in his scientific career, from anatomy and medicine to paleontology, came at the age of thirty-eight, when he returned to the University of Kansas as professor of geology. Kansas was the scene of his first inspiration in paleontology, and here his fossil studies and vigorous health marked the happiest period of his life. He taught both vertebrate and invertebrate paleontology, anatomy, and medicine, and several of his students have achieved distinction in these fields.[3] With respect to the breadth of his studies and of his influence at this time, his life was comparable only to that of Joseph Leidy, who, it will be recalled, was at once an anatomist, a physician, a paleontologist and a microscopist of distinction. He soon began to publish studies on the Cretaceous reptiles of Kansas. Henceforth Kansas plesiosaurs and turtles, mosasaurs and pterodactyls, were the subjects of a long list of papers mostly in the *Kansas University Quarterly,* from 1890 to 1899, with occasional articles on Kansas fossil mammals (*Platygonus, Aceratherium, Teleoceras fossiger*). Meanwhile he made many explorations of the Cretaceous of Kansas for fossil reptiles. At Kansas University Williston also kept up his two avocations of anatomy and dipterology; he served as professor of anatomy and dean of the medical school. He also continued to publish many papers on recent diptera. He accomplished a great work on this group and became the leading dipterologist of the United States. His studies culminated in the preparation of his "Manual of North American Diptera," a book which is indispensable to a beginner in dipterology and a very great convenience to advanced workers.

PALEONTOLOGIC WORK IN KANSAS[4]

Williston's paleontologic contributions on the Cretaceous fauna of Kansas began in 1879 with a short paper entitled "Are Birds Derived from Dinosaurs," and included fifty-three communications, chiefly to the Kansas Academy of Science, the *Kansas University Quarterly,* and the University Geological Survey of Kansas; also three volumes on the "Cretaceous Fishes" in cooperation with Alban Stewart; and "Paleontology (Upper Cretaceous)," Part I., Volume IV., of the University Geological Survey, which was chiefly prepared by Williston with the assistance of his students Adams, Case and McClung, and is a thorough review of the geology and marine fauna of the Cretaceous seas, containing the first clear distinctions and restorations of the great Kansas mosasaurs, *Clidastes,*

[3] Among these paleontologic students, who have since become known for their researches, were: E. C. Case, C. E. McClung, Roy L. Moodie, Herman Douthitt, Alban Stewart, Elmer S. Riggs, Barnum Brown, M. G. Mehl, E. B. Branson and E. H. Sellards.

[4] These notes on Williston's work on fossil reptiles and amphibians have been prepared in collaboration with Professor W. K. Gregory of the American Museum of Natural History.

Platecarpus and *Tylosaurus*. This work became the standard for all subsequent researches of Osborn, Wieland and others on the Cretaceous fauna. It contains some admirable restorations of mosasaurs and other fossils which may be compared with those of Dollo from the Maestrichtian of Belgium. The second part, Volume VI. of the University Geological Survey, covering the Carboniferous and Cretaceous, published in 1900, included the Cretaceous fishes alluded to above, and the Carboniferous invertebrates by Joshua W. Beede.

Williston concluded his studies of the Cretaceous fauna during the early years of his professorship in Chicago, beginning in 1902. Thus his work on the Kansas Cretaceous fauna, following the very disjointed contributions of Leidy, Marsh and Cope based on inferior material, marks the turning-point in this field to the new order of description and generalization based upon complete material, including even the skin impressions of several great mosasaurs. In his observations on the mosasaurs, plesiosaurs, pterodactyles and marine turtles, and the birds with teeth, *Odontornithes,* he placed the osteology of these several animals on a much more secure basis, adding a number of new generic types, such as a short-necked plesiosaur, *Dolichorhynchops osborni.*

His first contribution to the phylogeny and classification of the Reptilia as a whole appeared in 1905 and was followed by his important discussion of this subject entitled "The Phylogeny and Classification of Reptiles," *Journal of Geology,* August, 1917. In this article, which expresses his mature opinions, he departed from his previous conservative attitude towards classification and proposed to add two subclasses of reptiles, the Anapsida and the Parapsida, to the subclasses previously proposed by Osborn, namely, the Synapsida and the Diapsida, making a fourfold grand division of the Reptilia. Doubtless it was Williston's intention to fortify this system of classification in his forthcoming general work on the Reptilia.

WORK ON PRIMITIVE AMPHIBIANS AND REPTILES[5]

In 1902, at the age of fifty, Williston was called to the University of Chicago as head of the new department of vertebrate paleontology, a chair which he occupied with great distinction and with continued influence for the remaining sixteen years of his life. He now began to concentrate his attention more exclusively on vertebrate paleontology. During the first six years he continued his studies and publications on the Cretaceous reptiles; then he began to turn towards the study of far more difficult and obscure problems, namely, the relatively primitive amphibian and reptilian life of the Permian, where in several groups he marked the beginnings of the higher forms which he had previously studied, as well as the adaptive radiation of the lower forms to a great variety of habits and habitats.

In 1911 he published from the University of Chicago Press his volume, "American Permian Vertebrates," which comprises a series of monographic studies on some of the genera already noted. This work contains many new and original plates. His principal publication in 1914 was the book on "Water Reptiles of the Past and Present," in which his lifework on these animals was admirably combined with the results obtained by other workers. Williston had shown a bent for the harmonious study of form and function, of structure and habit, of environment and adaptation, which he applied with skill and originality to the interpretation of the highly diversified forms of aquatic life. He followed Eberhard Fraas of Stuttgart in making a special study of aquatic adaptations in the vertebrates; consequently his book on the water reptiles constitutes one of the most important contributions which we have on this subject. In 1917 he began a general work on the "Reptiles of the World, Recent and Fossil," upon which he was actively engaged up to his last illness; also the publication of his papers on *Edaphosaurus,* on the atlas-axis complex of reptiles, and, equally important, his brief

[5] See footnote, p. 276.

paper on the "Phylogeny and Classification of Reptiles," previously mentioned. During the last two years of his life he was also preparing a paper on new Permian reptiles. It is a matter of the deepest regret to all of Williston's colleagues in paleontology that he did not live to complete his great comparative work on the Reptilia, which would have summed up all his researches and observations and the facts stored in his mind which have never found their way into print.

A few of the more general features of Williston's life-work and character are as follows: He strove arduously through forty years of investigation to discover new material in the field and to widen our basis of facts in several distinct lines of investigation; he preferred to discover new facts rather than to reinterpret older ones or to adjust the interrelations of facts; in general, his material was notably of his own finding. Nevertheless, especially in his late years, he labored very successfully to classify and synthetize his material, and with it that which had been treated by other workers. Here his genial personal character and admirable relations with his colleagues shone forth; he was singularly appreciative of the work of other men and ready to adopt whatever he believed to be solid and enduring in previous attempts at classification. Thus Williston's work stands in contrast with that of Cope and Marsh, whose personal differences of opinion led to the setting up of two entirely distinct systems of classification as well as of nomenclature, irrespective both of priority and of merit. Williston's keen, broad knowledge of human anatomy, of the muscles as well as of the bones, doubtless aided his penetrating insight into the habits of the extinct animals, and while generally conservative and cautious, his phylogenetic studies and suggestions were of high value. His views on taxonomic standards[6] and on college and high-school education[7] were, like his views on paleontologic problems, characteristically sober, moderate and well considered, lighted up in their expression with his genial, half-humorous manner. He was ready to confess and appraise defects or faults on his own side, but quick to resent exaggerated accusations and criticisms from the other side.

His friends and colleagues met him last at the Pittsburgh meeting of the Paleontological Society of America, December 30, 1917, and enjoyed a few of his short and characteristically enthusiastic communications and discussions. With Dr. Holland, myself and many other warm friends he stayed the old year out and saw the new year in at the society smoker. He returned home quite suddenly, and this was the last occasion on which we were privileged to enjoy his genial presence, his humorous narratives, and his inspiring influence in paleontology.

Henry Fairfield Osborn
The American Museum of Natural History,
February 21, 1919

6 What is a Species,'' *Amer. Nat.*, XLII., 184–94.

7 ''Has the American College Failed to Fulfill Its Function?'' *Proc. Nat. Educ. Assn.* (1909), p. 526.

SCIENTIFIC EVENTS

THE BRITISH MINISTRY OF HEALTH BILL

The text of the Ministry of Health Bill, presented to the House of Commons on February 17, has since been published. According to *Nature* the bill differs little from the measure originally presented to the last Parliament. That it does differ to some extent, however, particularly in bearing signs of having been worked at and polished, is worthy of mention. The new bill carries the stamp of finality, and suggests that most of the State Departments performing health functions—the Local Government Board, the Board of Education, and the Insurance Commissioners especially—have arrived at arrangements more or less agreeable to all parties. The position as between the two first-named, for example, is shown to be fairly easy. Even as regards the place to be taken by the Insurance Commissioners, there is less reason for dissatisfaction, and concessions no doubt have been made by the various bodies and individuals concerned. Speaking generally, the measure

is a hopeful one, and inspired the feeling that we are well on the way to the establishment of the Ministry. The tone adopted by Dr. Addison is significant of this also, as is the translation of Sir George Newmann to the Local Government Board, and the granting to him of the title of "chief medical officer," with the status of a secretary of the board.

Nature continues: "One part of the bill which has been carried over unaltered from its predecessor is that relating to the appointment of consultative committees, and Dr. Addison, by his utterances, has shown himself to be firmly wedded to this idea, and expectant of results of great value from the work to be done by these bodies. The Consumers' Council at the Ministry of Food, which may be regarded as more or less analogous, though it was occasionally sneered at, must have assisted the food controller considerably. There is no reason to suppose that the Ministry of Health consultative committees will be any less helpful. Indeed, since they are to consist of carefully selected experts on matters having a bearing on national health, they are almost bound to be more valuable. In any event, the consultative committee idea has this to recommend it: that it will popularize health work. The committees will serve as a most effective link between the department doing the work and those for whose benefit the work is done. The department and the workers will be less cloistered; the workers and those who are worked for will be more intimately associated. The public will see and hear of what is being done, and will come to recognize the necessity for assisting in, and taking advantage of, the efforts made. So far there have been remarkably few comments on the bill, but on the whole the reception has been entirely favorable."

THE COLLEGE OF FISHERIES AT THE UNIVERSITY OF WASHINGTON, SEATTLE

The College of Fisheries just established by the University of Washington, at Seattle, enjoys the distinction of being the only one in the world outside of Japan. The Imperial Fisheries Institute at Tokio is a government institution and has been in existence since 1897. It has so conclusively proved its worth that a number of subsidiary schools have been established in the various provinces of Japan.

When the matter of the establishment of a College of Fisheries in this country was first broached by Dr. H. M. Smith, U. S. Commissioner of Fisheries, his attention was called to the fact that Seattle is the only American city within whose corporate limits, or in territory immediately adjacent, can be found in active operation practically every type of plant used in turning the raw fishery material into all forms of manufactured articles both for food and for use in the arts and sciences; fishery operations were carried on even in Seattle harbor; while the great salmon, halibut, cod and herring fleets operating in Alaska waters had their headquarters mainly in the city, outfitting there and bringing back the products for shipment to all parts of the world; also that one of the leading universities of the country was already established there and could take up the work.

The College of Fisheries will offer a four-year course divided into three divisions—Fishing, Technological and Fish Cultural. Students will be given as much practical training as possible in the college, but for certain periods in the last two years of the course will be expected to pursue their studies by work in commercial establishments devoted to the preparation of fishery products, aboard fishing vessels, or at hatcheries.

As the university is a state institution, an important part of the work of the College of Fisheries will be in rendering assistance and advice whenever called upon by the state authorities, and also to aid the commercial fishermen not only of the state but of the nation in solving the many problems which beset them, and to aid in the conservation and perpetuation of our wonderful fishery resources. Research work along the lines of utilization of hitherto neglected species, and of waste products, will be carried on and it is hoped will result in materially increasing the wealth of the state and nation.

The director, Mr. John N. Cobb, who is also

professor of fisheries, is known in connection with the economic fisheries of the United States, and has been active in the industry since 1895, when he was appointed a field agent of the U. S. Bureau of Fisheries.

BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE spring meeting of the American Chemical Society will be held with the Western New York Section in Buffalo, April 7 to 11, inclusive. There is every prospect that the meeting will be one of the largest ever held by the American Chemical Society as unusual interest has developed in problems of reconstruction, in the future utilization of war-time products, in heretofore secret information on chemistry warfare that can now be released, in the development of a comprehensive compendia of the literature of chemistry, and in many other problems which the Buffalo meeting will consider. A large number of chemists who have already signified their intention to be present assures also an unusual opportunity for meeting and discussing chemical problems with chemists who have been closely in touch with the nation's affairs. The Western New York Section is making arrangements for interesting excursions to industrial plants of importance.

Registration will take place at the Hotel Statler beginning at 3 P.M., Monday, April 7. An information bureau will be located at the hotel, and competent guides placed at all railroad stations. The general program is as following:

MONDAY, APRIL 7

4.00 P.M.—Council meeting at the University Club. Dinner for the council as guests of the Western New York Section at 6.30 P.M.

TUESDAY, APRIL 8

9.30 A.M.—General Meeting, Hotel Statler. "The Future of American Chemical Industry," by Wm. H. Nichols, President American Chemical Society.

One other general address to be announced.

2.30 P.M.—General Symposium on the Chemistry and Technology of Mustard Gas. Wilder D. Bancroft, chairman. Numerous interesting papers are offered. These will take up the whole of the afternoon of Tuesday and may continue on Wednesday morning in the Biological, Physical and Inorganic, and Organic Divisions.

8.15 P.M.—Smoker, Hotel Statler.

WEDNESDAY, APRIL 9.

Divisional meetings—9.30 A.M., 1 P.M. and 2.30 to 5.30 P.M., at Technical High School.

6 P.M.—Dinner to Council at Canisius College.

8.30 P.M.—At Hutchinson High School—Public Address, "A Chemical Story," by Edgar F. Smith, Provost of the University of Pennsylvania.

THURSDAY, APRIL 10

9.30 A.M. to 1 P.M.—Divisional meetings.

2 P.M.—Excursion. National Aniline & Chemical Company.

7 P.M.—Banquet—place to be announced. The capacity of the hall requires that only 400 tickets be issued.

The usual meetings will be held by all the Divisions except the Fertilizer Division, and by the Rubber Chemistry Section, with the following special program: The Division of Industrial Chemists and Chemical Engineers will make a special effort on papers on the probable future of those chemicals which have been abnormally stimulated during the war and on the library of the industrial laboratory. The Pharmaceutical Division announces a symposium on "The Possibilities in Drug Research." The Rubber Chemistry Section will apply for permission to organize at this meeting as a division.

Excursions are being arranged to include the works of the Buffalo Foundry and Machine Company; J. P. Devine and Company; Larkin Company; Municipal Laboratories and Water Purification Works; Oil Crushers; Pratt and Lambert, varnish makers; Spencer Kellogg Company; and tour of the city. Also, excursion to Niagara Falls, including visit to Power Plant, luncheon at Chamber of Commerce, pictures and exhibits of Niagara Falls products, drive along the Gorge and visit to Canadian side and Victoria Park. To accomplish the full program of excursions, it may be necessary to arrange for part of these excursions on Saturday.

SCIENTIFIC NOTES AND NEWS

THE annual meeting of the National Academy of Sciences will be held at the Smithsonian Institution in Washington on April 28, 29, and 30. The William Ellery Hale Lecture will be given by James Henry Breasted, professor of Egyptology and oriental history, University of Chicago, on "The Origin of Civilization."

COLONEL HARVEY CUSHING, of the Harvard Medical School, has returned to the United States.

LIEUTENANT-COLONEL J. H. HILDEBRAND, who has recently been Commandant of Hanlon Field, near Chaumont, France, which included the Experimental Field and the A. E. F. Gas Defense School of the Chemical Warfare Service, has returned after an absence of a year in France to his position of professor of chemistry in the University of California.

MAJOR C. B. STANTON, formerly professor of civil engineering at the Carnegie Institute of Technology, who has been with the 15th Engineers in France for nearly two years, has notified the dean of the Science School that he has been appointed a professor in the American University for American soldiers at Beaune, France. Major Stanton was with his regiment at Bordeaux awaiting orders to board a transport and come home when he received the unexpected order of reporting to this "soldier university" as professor of civil engineering.

MAJOR WILLIAM B. HERMS, associate professor of parasitology in the University of California, has resumed his university duties. Major Herms has been serving with the Sanitary Corps of the U. S. Army for a little over a year, stationed since April, 1918, at the port of embarkation, Newport News, Va., where he was in charge of malarial drainage operations, delousing stations and assisting in general sanitary inspection.

PROFESSOR FRANK E. MORRIS has returned to the Connecticut College for Women as professor of psychology and ethics, which position he left last year when he enlisted in the psychological department of the Sanitation Corps of the Army.

LIEUTENANT A. C. CHANDLER, assistant professor of zoology at the Oregon Agricultural College on leave of absence, has been ordered to the front with the American soldiers to make a study of rat parasites in France.

DR. LIVINGSTON FARRAND, chairman of the central committee of the American Red Cross, sailed for France on March 9, to be gone until the latter part of April. Having set in motion at headquarters the plans for the future of the Red Cross, Dr. Farrand goes abroad to study the organization's problems in Europe, and to confer with Henry P. Davison, formerly chairman of the war council, who is now at Cannes arranging for the international conference of Red Cross societies called to meet at Geneva 30 days after the declaration of peace. Dr. Farrand has arranged to have a number of American health experts join him at Cannes for the purpose of conferring with similar experts from the allied countries relative to matters that are to be taken up at Geneva.

DR. T. A. HENRY, superintendent of the laboratories at the Imperial Institute, London, has been appointed director of the Wellcome Chemical Research Laboratories, London. Dr. F. L. Pyman, the former director of these laboratories, has accepted the professorship of technological chemistry in the College of Technology, University of Manchester.

DR. H. C. TAYLOR, of the University of Wisconsin, has been appointed to be chief of the office of farm management of the Department of Agriculture.

PROFESSOR WILLIAM D. HURD, director of the Massachusetts Agricultural College, has resigned and will enter the service of the National Fertilizer Association. He is to have charge of educational projects in the middle west. Professor Hurd undertook the organization of the state system of extension work in 1909. There are now twenty full-time workers at the college engaged in projects of food production, distribution and conservation.

DR. ARTHUR LACHMAN, formerly professor of chemistry in the University of Oregon, is

now connected with the Great Western Electro-Chemical Co., San Francisco, Cal.

The annual meeting of the District of Columbia Chapter of the Society of the Sigma Xi was held in the auditorium of the National Museum, on March 6. Major R. M. Yerkes, Sanitary Corps, U. S. Army, gave an illustrated lecture on the "Relationship of Army Mental Tests to Education and Vocational Guidance." Officers for the ensuing two years were elected as follows: *President,* C. L. Shear; *Vice-president,* H. L. Shantz; *Secretary,* M. W. Lyon, Jr.,; *Treasurer,* D. Roberts Harper 3d; *Councillors,* Charles E. Tullar and C. A. Briggs.

A Canadian branch of the American Phytopathological Society was recently organized. The purpose of the organization is to correlate the work of plant pathologists in Canada and keep them in closer touch with each other, at the same time retaining a close union with the plant pathologists in the United States. The officers are: Professor J. E. Howitt, *president;* Mr. W. A. McCubbin, *Vice-president;* Dr. R. E. Stone, *Secretary-treasurer.*

The following officers and council of the Royal Astronomical Society were elected at the annual general meeting on February 14: *President:* Professor A. Fowler; *Vice-presidents:* Sir F. W. Dyson, Astronomer Royal, Dr. J. W. L. Glaisher, Major P. A. MacMahon, and Professor H. F. Newall; *Treasurer:* Mr. E. B. Knobel; *Secretaries:* Dr. A. C. D. Crommelin and Rev. T. E. R. Phillips; *Foreign Secretary:* Professor H. H. Turner; *Council:* Professor A. E. Conrady, Dr. J. L. E. Dreyer, Professor A. S. Eddington, Brig.-Gen. E. H. Hills, Mr. J. H. Jeans, Dr. Harold Jeffreys, Mr. H. S. Jones, Lieutenant-Colonel H. G. Lyons, Mr. E. W. Maunder, Dr. W. H. Maw, Professor J. W. Nicholson, and Lieutenant-Colonel F. J. M. Stratton.

We learn from *The British Medical Journal* that a House of Commons Medical Committee has been formed to include all medical members and other members of the House of Commons interested in scientific matters akin to medicine. All the medical members, excepting the ministers, have joined, and also Sir Philip Magnus (member for the University of London) and Sir Henry Craik (one of the members for the Scottish Universities). The chairman is Sir Watson Cheyne, and the secretary Major A. C. Farquharson. The executive committee consists of Sir William Whitla, Lieut.-Colonel Nathan Raw and Captain Elliott. The objects of the committee are to exchange opinions so as to secure representation of agreed views on medical subjects in Parliament. The committee is open to receive representations on all such matters from the colleges and corporations, and from societies and associations, and will hold conferences when considered desirable. It will not allow itself in any way to be identified with any one particular body. A subcommittee has been appointed, consisting of Colonel Nathan Raw (England), Sir Watson Cheyne (Scotland), and Sir William Whitla (Ireland), to watch the ministry of health in its progress through the House.

Dr. H. D. Curtis, of the Lick Observatory, Mount Hamilton, California, gave an address on "Modern Theories of Spiral Nebulæ" at a joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington on March 15.

The death is announced on February 19, at eighty-five years of age, of Dr. F. Du Cane Godman, F.R.S., trustee of the British Museum, and distinguished for his work in natural history, especially ornithology.

An item concerning the "Goodrich conservation bill," printed on page 213 of Science for February 10, applies to the state of Indiana, and not to Illinois.

Malcolm Playfair Anderson, a well-known naturalist and explorer, was killed in Oakland, California, on February 21, by the fall of a beam in a shipyard. Mr. Anderson was a graduate of Stanford University, a son of Dr. Melville Best Anderson, professor emeritus of English literature at Stanford. He was an accomplished ornithologist, his work having been largely in China and Japan, where he was head naturalist of the Duke of Bedford's ex-

plorations in Eastern Asia. He was brother of Robert V. Anderson, late of the U. S. Geological Survey, now representing the War Trade Board at Stockholm.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late Morton F. Plant, the Connecticut College for Women receives a bequest of $250,000.

Two years ago Professor and Mrs. Herdman gave to the University of Liverpool, the sum of £10,000 to establish a chair in memory of their son, Lieutenant George A. Herdman, who was killed in action. *Nature* states that they have now made a further gift of £10,000 for the purpose of establishing a chair of oceanography with special reference to fisheries. The council of the university has accepted this gift with grateful thanks, and has resolved that (1) Professor Herdman be appointed professor of oceanography as from October 1 next; (2) Dr. J. Johnson succeed him on October 1, 1920, and during the twelve months from October 1 next be lecturer on oceanography at the salary derived from the endowment.

THE senate of the University of Cambridge has approved the plan for the establishment of the degree of doctor of philosophy. The syndicate dealing with this question recommends that, subject to certain exemptions, candidates for the degree, before submitting a dissertation, must have pursued a course of research for not less than three years, and the senate has determined that of this period one year in the case of a graduate of the university and two years in the case of other students must be spent in Cambridge.

SIR OLIVER LODGE has retired as principal of Birmingham University.

THE resignation of Dr. Harry B. Hutchins, as president of the University of Michigan, which was presented on October 12, 1916, has now been accepted by the regents to take effect on June 30. It is reported that Dr. James Rowland Angell, professor of psychology and dean of the department of arts and sciences of the University of Chicago, will be asked to accept the presidency.

DR. JOHN JOHNSTON, secretary of the National Research Council in Washington, has been appointed professor of chemistry in the Graduate School of Yale University. Professor Johnston is a graduate of the University of St. Andrews.

LIEUTENANT KARL SAX, recently discharged from military service in the coast artillery at Fort Amador, Canal Zone, Panama, has been appointed instructor in genetics at the University of California.

DISCUSSION AND CORRESPONDENCE

DESMOGNATHUS FUSCUS (SIC).

TO THE EDITOR OF SCIENCE: Professor Wilder's letter recalls a proposal made by Mr. Oldfield Thomas and myself, a proposal worth repeating. Zoological nomenclature has many inevitable difficulties to overcome, and it will save time and disputes if there be removed from it the extrinsic burden of trying to conform with the rules of Greek and Latin grammar. Let the convention be established that the name of a genus, whatsoever its derivation, be regarded as masculine when the genus denotes a group of living animals, feminine if it denote a group of living plants, and neuter if it denotes a fossil animal or plant. Let it be agreed that the scientific name of an existing species may be changed to accord with this conventional sex where possible, and that in the making of new names, the accord should be made by the author, corrected by the editor or by any subsequent writer. This would simplify matters and, in a considerable proportion of instances would give useful information.

P. CHALMERS MITCHELL

ZOOLOGICAL SOCIETY OF LONDON

TO THE EDITOR OF SCIENCE: I have read with interest and some amusement the letter by Mr. H. H. Wilder, on "Desmognathus fuscus [sic]." It seems to me to lend additional support to the suggestion made years ago by my friend, the Rev. T. R. R. Stebbing, that

all zoological generic names should be regarded as masculine. I enclose herewith a copy of his article on the subject: perhaps you could quote some portions of it in SCIENCE in order to remind the zoological world of an eminently reasonable proposal.

WM. EVANS HOYLE

NATIONAL MUSEUM OF WALES

My suggestion is that a technical specific name in Zoology should be released from the obligation of agreeing with the supposed gender of the generic name to which it is attached.

Simplicity would be attained by acceptance of the convention that in zoology a generic name, whatever its termination, is to be regarded as of the masculine gender.

That some scholarly ear might occasionally be offended, is a minor disadvantage compared with the general utility of the convention. A famous historical character was hailed as "our king Maria Theresa," without any influence on the actual sex of that distinguished person. Similarly many men have been named Maria without in consequence becoming women or in any degree effeminate. The termination of a generic name is a very indifferent reason for determining a zoological species as either masculine, feminine, or neuter, seeing that the species itself usually includes two of the genders, and sometimes all three. Very commonly all the normal individuals of a species are either of the male or female sex. Yet, under the existing rule, the species must sometimes have a neuter name, as though it referred to something inorganic or of undiscriminated sex. Such considerations, however, are of subordinate importance compared with the troublesome character of the present arrangement. As every one is aware, it repeatedly happens that by accessions to knowledge, genera become unwieldy and have to be subdivided. The new names, it may be, do not agree in gender with the old, and then the transferred species must all have their terminations altered. But, apart from this consequential trouble, naturalists for ages past have found the determination of generic genders a stumbling-block. How much more is this likely to be the case in the future, with the continuous decline of classical studies! Without actual examples, few would credit the difficulties encountered and the errors committed by naturalists in their endeavors to comply with the existing rule or practise.—T. R. R. Stebbing in *Knowledge* (1910).

HAY FEVER AND THE NATIONAL FLOWER

TO THE EDITOR OF SCIENCE: The attention of the American Hayfever Prevention Association has been called to the article on "Hay Fever and the National Flower" in a recent issue of your journal.

The research department of this association, which was established in 1915, has made a thorough investigation of the causes of hay fever, being assisted in this work by specialists and botanists in practically every state of the union. The pollens of all the most common plants and trees have been tested and their relation to hay fever established.

Generally speaking, the principal causes of fall hay fever in the northern, eastern and southern states[1] are the pollens of the ragweeds (Ambrosiaceæ), these being replaced in the Pacific and Rocky Mountain States[2] by the wormwoods (artemisias) The chief causes of spring hay fever are the pollens of the grasses in all sections. About five per cent. of hay fever cases are due to other pollens. The golden rod, however, is not included in these, having proven a clear "alibi."

For those not already familiar with the subject, the following statement is made:

THE GOLDEN ROD IS NOT RESPONSIBLE FOR HAY FEVER

1. It does not conform to the description of hay fever plants, which is as follows:[3] (1) They are wind-pollinated, (2) very numerous, (3) the flowers are inconspicuous, without bright color or scent, and the pollen is formed in great quantities. The flowers of the golden rod are insect-pollinated, have bright colors and scent, and the pollen is not formed in large quantities.

[1] "Hayfever: Its Cause and Prevention," W. Scheppegrell, M.D., *Journal of the American Medical Association*, March 4, 1916.

[2] "Hayfever: Its Cause and Prevention in the Rocky Mountain and Pacific States," W. Scheppegrell, M.D., United States Public Health Reports, July 20, 1917.

[3] "Hayfever and Its Prevention," W. Scheppegrell, M.D., United States Public Health Reports, July 21, 1916.

2. The golden rod continues to bloom for several weeks after the hay fever season is over.[4] In western North Carolina, for instance, the hay fever season concludes about October 1, but the Canadian golden rod (*Solidago canadensis*) brightens the autumn landscape until November. In our hay fever clinic at the Charity Hospital of New Orleans, the fall hay fever season concludes about October 26, but the golden rod continues to bloom until December.

3. Our research department exposes its atmospheric-pollen-plates in various parts of the United States, and in this way, the atmospheric-pollens are caught and examined. The pollens of the golden rod are never found on these plates, proving that this pollen is not atmospheric. Unless the pollen is in the air, as in the cases of the ragweeds, grasses and other wind-pollinated plants, it can not cause hay fever unless the nostrils are applied directly to the flower, or are used in large quantities for room decorations, in which case the pollen may fall within the limited space.

The pollen of the golden rod may cause a reaction when applied directly to the nostrils, or when used in large quantities for room decorations. As far as being a cause of hay fever, however, it is absolutely negligible. It is one of our most beautiful flowers, and well merits its selection as the national flower of the United States.

W. Scheppegrell

American Hayfever Prevention Association; Chief of Hayfever Clinic, Charity Hospital; Ex-president American Academy of Ophthalmology and Otolaryngology

SCIENTIFIC BOOKS

Manual of Meteorology, Part IV. *The Relation of the Wind to the Barometric Pressure.* By Sir Napier Shaw, Cambridge, University Press. 1919.

The British Meteorological Office during the past four years has been called upon to answer a good many questions put to them by the Army, Navy and Air Services. The requests for detailed information regarding wind, weather and the structure of the atmosphere were numerous and urgent. For in both offensive and defensive operations the military authorities suddenly realized how all important a knowledge of aerography was. In attempting to give definite data, Sir Napier Shaw, as Scientific Advisor to H. M. Government and chairman of the Meteorological Committee, says that he found as a guiding principle of great practical utility, the relation of the wind to the distribution of pressure. The underlying assumption is that the flow of air in the free atmosphere follows very closely the laws of motion under balanced forces, depending upon the *spin* of the earth and the *spin* in a small circle on the earth.

There are eleven chapters in the book. The opening chapters give details of the determination of the pressure gradient and the wind. Land and sea relations of surface wind to the gradient, turbulence in relation to gustiness and cloud sheets, eddy clouds, the dominance of the stratosphere, coastal refraction of isobars and the dynamical properties of revolving fluid in the atmosphere, are treated in some detail in successive chapters.

Space permits of but one quotation from the book and that is almost the last paragraph; but here the author drives another nail in the coffin of the convectional theory of the cause of cyclones.

> It has long been supposed that the variations of temperature at the surface are themselves the cause of the original circulation of the cyclone, but it is much more easy to explain convection along the core as the effect of an existing circulation above, than *vice versa*, and there are so many examples of convection attended even by copious rainfall which produce no visible circulation that it is difficult to regard convection from the surface as a sufficient cause of our numerous depressions.

Sir Napier deals at some length with the relation between the surface wind and the geostrophic wind at sea-level. This is pecul-

[4] "Susceptibility to Hayfever, and Its Relation to Heredity, Age, and Seasons," W. Scheppegrell, M.D., United States Public Health Reports, July 19, 1918.

iarly his own field, and is in fact a development of the past six years. It is a distinctive contribution of the British school of aerographers. We may explain that the balance between pressure and velocity of air flow, or what is known as the strophic balance, leads to an equation for the gradient wind of the following form:

$$s = 2\omega v\rho \sin\phi \pm v^2\rho \cot r/E$$

The first term in the right-hand member of the equation represents velocity due entirely to the earth's rotation and hence is known as the geostrophic wind. The other is known as cyclostrophic. Only a few months ago J. S. Dines called attention to a rather remarkable outcome of this equation, where in the case of a path concave to the "low," velocities of the order of $6m/s$ for normal counter-clockwise rotation, and $46m/s$ for rotation in the opposite direction, appear to be possible. Thus a depression revolving with high speed in a *clockwise* direction in the northern hemisphere is dynamically possible. There are reasons why such an eddy on a large scale might not be established or last long, but small area eddies such as those around high buildings, etc., evidently can be set up with rotation either clockwise or anti-clockwise. This raises the question, How often are dust-whirls, tornadoes, and waterspouts observed with a clockwise rotation?

Sir Napier Shaw uses as a frontispiece a chart showing paths of the centers of some notable cyclonic depressions of long duration. One is the path of a *baguio* traced by McAdie from lat. 15° N. in the western Pacific, starting on November 20, 1895, and reaching the Oregon-California coast January 12, 1896, a rather definite duration of 54 days at sea and a probable history of 4 days more in the United States and 5 days over the North Atlantic. Two other long duration storm paths are given.

These paths of long duration are significant in connection with origin, directive force and persistence of structure of cyclones and anticyclones. The most pressing question to-day before aerographers is accurate knowledge of the driving forces of a depression, and the directive resultant. There can be no accurate forecasting without this knowledge.

We are promised three more volumes from the University Press; one, a general survey of the globe and its atmosphere. A second on the physical properties of the atmosphere, and a third, a formal exposition of the dynamics and thermics of the atmosphere.

Sir Napier Shaw is to be congratulated not only on the output from his own industrious pen, but upon what he has accomplished in stimulating the young men around him, Lempfert, Dines, Gold, Cave, Taylor and others.

A. M.

THE NATIONAL ACADEMY OF SCIENCES

The eleventh number of Volume 4 of the *Proceedings of the National Academy of Sciences* contains the following articles:

The "Homing Habits" of the Pulmonate Mollusk Onchidium: Leslie B. Arey and W. J. Crozier, Bermuda Biological Station for Research, Dyer Island, Bermuda. *Onchidium floridanum* lives during high tide in "nests," *i. e.*, rock cavities, containing a number of individuals. The individuals leave the nest in low water to feed, and return simultaneously to it before the tide rises again, giving evidence of homing behavior.

Growth and Duration of Life of Chiton Tuberculatus: W. J. Crozier, Bermuda Biological Station for Research, Dyer Island, Bermuda. The growth curve is obtained on the assumption that the age of a chiton may be estimated from the growth-lines upon its shell. The mean duration of life is probably a little less than eight years.

Growth of Chiton Tuberculatus in Different Environments: W. J. Crozier, Bermuda Biological Station for Research, Dyer Island, Bermuda. Growth curves obtained under different conditions are compared.

The Interferometry of Vibrating Systems: C. Barus, Department of Physics, Brown University. The high luminosity of the achromatic interferences and the occurrence of but

two sharp fringes make it possible to utilize them even in cases when the auxiliary mirrors vibrate. The vibration interferometer is quite sensitive, provided the average currents are of the order of several microamperes.

On the Essence of Physical Relativity: Sir Joseph Larmor, Cambridge, England. A general discussion of the physics underlying relativity, with particular reference to an article by Leigh Page.

Gravitational Attraction in Connection with the Rectangular Interferometer: Carl Barus, Department of Physics, Brown University. The rectangular interferometer is so sensitive in the measurement of small angles that it may be used for the measurement of the Newtonian constant of gravitational attraction.

The General Character of Specific Heats at High Temperatures: Walter P. White, Geophysical Laboratory, Carnegie Institution of Washington. The general law covering the behavior of atomic heats from the lowest temperatures up demands that at sufficiently high temperatures all atomic heats at constant volumes should have the value 5.96. A contrary hypothesis has been made, namely, that atomic heats continue to increase with the temperature. The substances here examined give evidence that the atomic heats do increase above the value 5.96.

On Certain Projective Generalizations of Metric Theorems, and the Curves of Darboux and Segre: Gabriel M. Green, Department of Mathematics, Harvard University. The continuation of earlier work by the same author in the *Proceedings.*

The Rectangular Interferometer with Achromatic Displacement Fringes in Connection with the Horizontal Pendulum: Carl Barus, Department of Physics, Brown University.

THE twelfth number of Volume 4 contains the following articles:

The Absorption Spectrum of the Novae: W. S. Adams, Mount Wilson Observatory, Carnegie Institution of Washington. A discussion of Nova Aurigæ of 1892, Nova Persei of 1901, Nova Geminorum of 1912, and Nova Aquilæ of 1918. The displacements of the lines in all these stars are directly proportional to wavelengths, and divide themselves into two pairs of equal amount. Of these the first pair of stars has exactly twice the displacement of the second. In the case of Nova Aquilæ, there is a progressive increase in the values of the displacements of the absorption lines at successive dates. Various hypothetical explanations are discussed.

On Jacobi's Extension of the Continental Fraction Algorithm: D. N. Lehmer, Department of Mathematics, University of California. A closer study of Jacobi's expansion reveals a number of remarkable points. Six theorems are stated.

A Characterization of Jordan Regions by Properties having no reference to their Boundaries: Robert L. Moore, Department of Mathematics, University of Pennsylvania. The theorem is proved: In order that a simply connected, limited, two-dimensional domain R should have a simple closed curve as its boundary it is necessary and sufficient that R should be uniformly connected im kleinen.

A Biometric Study of Human Basal Metabolism: J. Arthur Harris and Francis G. Benedict, Nutrition Laboratory and Station for Experimental Evolution, Carnegie Institution of Washington. An analysis of measurements on 136 men, 103 women, and 94 new-born infants.

Sex and Sex Intergrades in Cladocera: Arthur M. Banta, Station for Experimental Evolution, Carnegie Institution of Washington. The presentation of facts in regard to *Cladocera,* with the discussion of their significance with regard to sex intergrades in general, leading to the tentative conclusion that sex is always relative and that while most individuals of whatever species are prevailingly male or prevailingly female, every individual may have something of the other sex intermingled with its prevailing sexual characters.

On the Method of Progression in Polyclads: W. J. Crozier, Bermuda Biological Station for Research, Dyer Island, Bermuda. In turbellarians generally, muscular operations analogous to those executed by the foot of chitons

and of gastropods are essentially concerned in creeping locomotion.

The Phylogeny of the Acorn Barnacles: Rudolf Ruedemann, State Museum, Albany, N. Y. The derivation of an *Eobalanus* from a *Rhinocaris*-like phyllopod is illustrated in a set of diagrams.

Possible Derivation of the Lepadid Barnacles from the Phyllopods: John M. Clarke, State Museum, Albany, N. Y. So far as present knowledge extends, the metamorphoses of the phyllopods into the two great branches of the barnacles were essentially contemporaneous.

Refractive Index and Solubilities of the Nitrates of Lead Isotopes: Theodore W. Richards and Walter C. Schumb, Wolcott Gibbs Memorial Laboratory, Harvard University. The difference in atomic weight of the lead (207.20 and 206.41) has no appreciable effect on the refractive index or on the molal solubility of the different samples of lead nitrate.

The Purification by Sublimation and the Analysis of Gallium Chloride: Theodore W. Richards, W. M. Craig and J. Sameshima. Wolcott Gibbs Memorial Laboratory, Harvard University. The method rests on the fact that gallium trichloride sublimes and distils at a low temperature, whereas the other chlorides likely to be associated with it are much less volatile.

The Purification of Gallium by Electrolysis, and the Compressibility and Density of Gallium: Theodore W. Richards and Sylvester Boyer, Wolcott Gibbs Memorial Laboratory, Harvard University. The method of separating gallium from indium by means of the different solubilities of the hydroxides in caustic alkali was tested without success; much more promising results were obtained by the electrolytic method. The compressibility of solid gallium was found to be 2.09×10^{-6}, and of liquid gallium 3.97×10^{-6}, nearly twice as great, although its volume is less. The density of the liquid was 6.081, and of the solid 5.885.

The Growth-rate of Samoan Coral Reefs: Alfred G. Mayor, Department of Marine Biology, Carnegie Institution of Washington. the growth rate of *Acropora, Porites, Pocillopra, Pavona, Psammocora* are given; and the weight of limestone added per year to the upper surface of the Aua reef-flat is estimated as 805,000 lbs. Other similar estimates are given.

The Distances of Six Planetary Nebulæ: Adriaan van Maanen, Mt. Wilson Solar Observatory, Carnegie Institution of Washington. The nebulæ N.G.C. 2392, 6720, 6804, 6905, 7008 and 7662 are examined. The parallaxes range from 0."002 to 0."021, and the diameters from 10,000 to 1,350 astronomical units.

National Research Council: Minutes of the Meeting of the Executive Board, July 9, August 13, September 9 and October 8.

We may summarize the articles in Volume 4 of the Proceedings as follows: Mathematics, 9; Astronomy, 11; Physics and Engineering, 25; Chemistry, 5; Geology and Paleontology, including Mineralogy and Petrology, 9; Botany, 3 (see also Genetics); Zoology, including General Biology, 12 (see also Genetics); Genetics, 6; Physiology and Pathology, 10; Anthropology and Psychology, 1; a total of 91 articles.

The division of these articles between members of the Academy and non-members is 39 and 52 respectively.

The list of institutions which have contributed three or more articles is as follows: Carnegie Institution, 15, divided as follows: Solar Observatory, 7, Nutrition Laboratory, 4, Geophysical Laboratory, 1, Marine Biology, 1, Station for Experimental Evolution, 1, Tortugas Laboratory, 1; Harvard University, 15; Brown University, 7; University of Illinois, 5; Bermuda Biological Station for Research, 4; University of California, 4; University of Chicago, 4; University of Pennsylvania, 4.

EDWIN BIDWELL WILSON
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
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SPECIAL ARTICLES

OPPORTUNITIES FOR CONTACT INFECTION[1]

AN outstanding feature of the influenza pandemic is the remarkable infectivity of the disease. There is scarcely a community in

[1] Published by permission of the Surgeon-General of the Army.

this country that has escaped its visitation. Once introduced it has spread from person to person with truly amazing speed. This is partially accounted for by the very short incubation period, from two or four days. This furnishes new foci of infection at a much more rapid rate than is the case with certain other infectious diseases which require from five to twenty days to develop. So much for the progress of the disease, once rooted in the individual, but just how the infection is passed about so widely is a matter that is less easy to explain. Are the causative organisms transmitted from person to person by contact, or are they mixed with dust from saliva-laden streets and scattered broadcast by the wind? The trend of modern thought is to regard contact or hand to mouth transmission as by far the more important. It is only at such times as we have just experienced that there is a tendency to question the adequacy of this method. Dust holds out certain allurements because of its ubiquity and there is just enough of the mysterious associated with airborne infection to be in keeping with a disease about which we know so little. Lest we wander too far from the truths which modern public health experience has taught us the following inventory of opportunities for contact transmision of disease is offered.

The writer recorded his chances of acquiring infections for an entire day. This list undoubtedly is typical for the average city dweller.

For the purpose of emphasis the items are recorded in detail:

1. Touched bathroom doorknob.
2. Touched toilet seat.
3. Touched toilet flush handle.
4. Touched chain on light.
5. Touched faucet handle. (Washed hands.)
6. Touched bathroom doorknob.
7. Touched knob of outside door.
8. Received paper from newsboy.
9. Grasped handle of trolley car.
10. Received transfer from conductor. (Gloves on hands from this time till entering restaurant.)
11. Grasped back of chair in restaurant.
12. Touched tumbler with hand.
13. Touched tumbler with lips.
14. Touched teaspoon with hand.
15. Touched teaspoon with lips.
16. Touched plate with hand.
17. Touched second teaspoon with hand.
18. Touched second teaspoon with lips.
19. Touched coffee cup with hand.
20. Touched coffee cup with lips.
21. Touched cream pitcher with hand.
22. Touched cereal dish with hand.
23. Touched toast with hand.
24. Placed toast in mouth.
25. Touched shredded wheat with hand.
26. Placed shredded wheat in mouth.
27. Touched second piece of toast with hand.
28. Placed second piece of toast in mouth.
29. Used handkerchief to nose.
30. Handled napkin.
31. Wiped mouth with napkin.
32. Touched back of chair.
33. Received check.
34. Received change from cashier.
35. Opened door.
36. Closed door. (Put on gloves.)
37. Used handkerchief to nose.
38. Handled toilet room door at office.
39. Touched swinging doors on toilet.
40. Touched toilet seat.
41. Touched flush handle.
42. Touched swinging doors on toilet. (Washed hands.)
43. Touched toilet room door knob.
44. Used handkerchief to nose.
45. Shook hands with visitor.
46. Received paper from visitor.
47. Used handkerchief to nose.
48. Shook hands with visitor.
49. Shook hands with second visitor.
50. Opened toilet room door.
51. Pressed toilet flush with hand.
52. Turned water faucet. (Washed hands.)
53. Opened lunchroom door.

54, 55, 56. Received three dishes from attendant.

57. Handled chair.
58. Handled water tumbler.
59. Carried glass to lips.
60. Put spoon in mouth.
61. Put fork in mouth.
62. Opened post office door.
63. Licked postage stamp handed out by clerk.
64. Opened post office door.
65. Opened office door.
66. Placed hand on rail.
67. Opened office door.

68. Grasped handle on trolley car.
69. Opened door of bank.
70. Grasped pen used by public.
71. Received bills from cashier.
72. Opened bank door.
73. Opened toilet room door.
74. Closed swinging doors.
75. Touched flush handle.
76. Opened swinging doors.
77. Touched faucet. (Washed hands.)
78. Opened toilet room door.
79. Pressed handle on drinking fountain with hand.
80. Handled toilet room door.
81. Pressed toilet flush.
82. Turned faucet handle. (Washed hands.)
83. Opened toilet room door.
84. Received newspaper.
85. Received change from newsboy.
86. Grasped car handle.
87. Received change from conductor. (Put on gloves.)
88. Opened restaurant door.
89. Handled chair.
90, 91, 92, 93. Handled knife, fork, spoon, tumbler.
94, 95, 96. Touched spoon, fork and tumbler to mouth.
97. Handled water pitcher.
98. Touched napkin.
99. Wiped mouth with napkin.
100. Grasped chair.
101. Used handkerchief to nose.
102. Handled cake.
103. Put cake in mouth.
104. Grasped chair.
105. Opened door.
106. Used handkerchief to nose.
107. Used toothpick, bringing hand to mouth.
108. Opened door to house.
109. Received paper from friend.
110. Friend laughed boisterously within spray range.
111. Used handkerchief to nose.
112. Closed bathroom door.
113. Pressed toilet flush.
114. Turned faucet handle. (Washed hands.)
115. Opened bathroom door.
116, 117. Shook hands with two people.
118. Touched light chain.
119. Passed candy to mouth with hands.

The above list shows 119 possibilities during the course of a day for acquiring infected material either on the hands, mouth or nose. We may sum up these incidents as follows:

Touching hands to articles that were or might have been touched by others immediately before	87
Shaking hands	5
Carrying to mouth articles possibly infected by others	17
Hand brought in contact with mouth directly.	2
Hand brought in contact with nose indirectly through handkerchief	7
Chances of acquiring infection through laughing of others	1
Chances of acquiring infection through sneezing of others	0
Chances of acquiring infection through coughing of others	0
Chances of acquiring infection through kissing.	0

There were 92 opportunities for infecting the hands directly with other hands or with articles just handled by others. Mere infection of the hands is of course immaterial. It is the carrying of the infected hand to the mouth or nose, which constitutes the danger. In the present instance the hand was brought in contact with the mouth or nose, either directly or through food, or through handling a handkerchief 14 times, 7 times in the case of the mouth and 7 in the case of the nose. This represents the experience of one to whom keeping hands out of the mouth is second nature. But what of the person who is unconscious of the hand to mouth habit? There is no question but that the hand travels to the mouth more frequently with the average individual.

There were seven opportunities of infecting the nose with the hand through the medium of the handkerchief. The influence of weather and climate on infection is suggested here by the fact that the colder or more changeable the weather the more frequently does the nose require attention and the opportunities for infecting the nose from the hand increase in proportion.

In making up this record of articles touched by the hands, it should be emphasized that only those instances have been recorded which offered the possibility of infection through

recent handling of the article by others. Contact with papers, pencils, etc., handled remotely by others have not been included.

Another point that stands forth is that our hands are dangerous to others only in proportion to the frequency with which we infect them with our mouth and nose. The present experience shows seven hand-to-nose contacts and but two direct hand-to-mouth contacts. The handkerchief thus looms up as a factor of importance. Through it we may infect our hands from our nose, which is dangerous to others, and also infect our nose with our hands which is dangerous to ourselves.

Several lessons of practical value suggest themselves from the above related experience. They are:

I. That we should use handkerchiefs one side of which is conspicuously colored or marked so that we may always apply the hands to one side reserving the other side for the nose. This will protect our own nose from our hands and help to prevent the infection of our hands.

II. That we should abandon the universal practise of shaking hands, substituting some other less intimate method of salutation.

III. That we should encourage means which will lessen the opportunity for public restaurant employees to handle eating utensils.

George T. Palmer,
Captain, Sanitary Corps, U. S. A.

A PRELIMINARY NOTE ON A BACTERIAL DISEASE OF FOXTAIL

During the month of September and up until the middle of November, 1918, a striking disease on foxtail (*Setaria glauca* (L.) Beauv.) was noticeable around Fayetteville, Ark. The disease was rather widespread in this vicinity and it is quite probable that it is prevalent throughout the state of Arkansas at least. The disease manifests itself as dark brown spots and streaks, varying in size from small, oval or roundish spots, 1–2 mm. in diameter, to elongated streaks, 2–3 cm. in length. The attacked areas are to be found on leaves, flowering stalks and glumes. The pathogen, a white, rod-shaped bacterium was isolated and obtained in pure culture. It was inoculated on healthy leaves by using a sterile, platinum needle and smearing the organism on the leaf. Within three to four days inoculated spots showed the characteristic browning of the tissue. The organism was then reisolated and obtained in pure culture from the inoculated spots.

Both by spraying and by needle smears this organism was successfully inoculated on wheat, oats, rye, barley, corn and Sudan grass; it was reisolated and obtained in pure culture from each of the above-named hosts. Infections were also obtained on sorghum and millet but no reisolations have been obtained from these up to the time of writing.[1] Judging from the appearance of infected plants in the greenhouse all the cereals mentioned, except corn and the various grasses of the *Sorghum* group, are quite seriously attacked. The effect on oats is not unlike the halo blight recently described by Miss Elliott[2] and it is likely that the organisms under discussion is the same as Mann's[3] *Pseudomonas avenæ*. However, the identity of the organism is still in doubt and the work is being continued.

H. H. Rosen
Agricultural Experiment Station,
University of Arkansas

1 Since this article was written the organism has also been reisolated from these hosts.

2 Elliott, C., "Bacterial Oat Blight," *Phytopath.* 8: 489, 1918.

3 Manns, T. F., "The Blade Blight of Oats," Ohio Agri. Exp. Sta. Bul. 210, 1909.

THE AMERICAN METRIC ASSOCIATION

The following is a summary of the proceedings of the second annual meeting of the American Metric Association (156 Fifth Avenue, New York City), held in Baltimore on December 27 and in Washington on December 28.

Mr. David A. Molitor, consulting engineer, outlined his work for the C. E. Schmidt Co., of Detroit, tanners. He found that about 500 different commodities were being purchased for the use of this company and that they were received in many different units of weight and measure. It became clear that economy would be effected by entering the weight or measure of all material received in

metric units. This step was taken with great success. The metric weights and measures were then used exclusively throughout the factory. The output of the factory was increased approximately 50 per cent. with the same working staff. The weighing in one department had previously been made by an expert in the old weights and measures. After the change to the metric system, this work was done by a laborer with fewer mistakes than formerly. Mr. Molitor estimated that a saving of approximately 20 per cent. could be effected in the bookkeeping and calculations of factories which introduced the metric weights and measures throughout.

Dr. C. O. Mailloux, consulting engineer, chairman of the United States Committee of the International Electro-Technical Commission, told of his practical experiences in the use of the metric system in the United States and foreign countries, describing his last interview with Sir John Wolfe Barry, who designed the London Bridge and other engineering enterprises in England. He expressed to Dr. Mailloux his firm conviction of the desirability and necessity for adopting the metric weights and measures in England and discussed the practical steps contemplated for their general use. Dr. Mailloux pointed out the fact that the electrical units throughout the world were based on metric weights and measures and that this in itself was indicative of their ultimate adoption for all purposes in America and England.

Mr. Jesse M. Smith, past president of the American Society of Mechanical Engineers, stated that he had been in close touch with the metric movement for fifty years. He had studied in Berlin during the winter following the Franco-Prussian War. The metric system was then used in the text-books and also for practical work throughout Germany. He had frequently used the metric system in America and other countries since then and believed it to be only a question of time when the metric system would be adopted in all parts of the world.

Professor Eugene C. Bingham, of Lafayette College, was appointed chairman of the Committee on Sections of the American Metric Association. The following resolution on this subject was adopted:

"*Resolved,* that the American Metric Association hereby requests the formation of local sections throughout the country."

United States Senator John F. Shafroth, read bill S5037, which he has introduced in congress and asked for a discussion on the subject. This bill is a step toward the general use of metric weights and measures, making exceptions where such seem to be advisable for special work. The bill was endorsed by the American Metric Association.

Secretary of Commerce, Honorable William C. Redfield was the principal speaker at the "Metric Dinner," held on the evening of the twenty-seventh. After outlining his practical experience as a manufacturer for thirty years and his travels in other countries in the interests of his export trade, he voiced the conviction that the metric weights and measures should and would be adopted for general use in the United States. The Secretary of Commerce said in part: "I believe that the metric system offers a return to simplicity, offers an effectiveness of thought, offers more to little children in our schools if you please, which we are not justified in withholding from them."

The following officers were elected for the year 1919: *President*—George F. Kunz, New York; *First Vice-President*—Wm. Jay Schieffelin, New York; *Second Vice-President*—Jesse M. Smith, New York; *Third Vice-President*—David A. Molitor, Detroit; *Treasurer*—Arthur P. Williams, New York; *Secretary*—Howard Richards, Jr., New York.

The following were among the resolutions passed:

"*Resolved,* that the American Metric Association hereby expresses its desire to cooperate more fully with those American industries and trades using and contemplating the use of metric weights and measures.

"*Resolved,* that the American Metric Association send greetings to the universities, colleges and other educational institutions and respectfully invite their cooperation in bringing in the general use of meters, liters and grams for the welfare of America."

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HORTICULTURE AS A PROFESSION[1]

THE advancement of civilization is marked by certain well-defined epochs. There are the old stone age and the new stone age, the age of bronze, the age of steam, the age of electricity. More recently events have moved forward with prodigious acceleration. We were no sooner beginning to think of the present as the age of the automobile, than the airplane rose above the horizon, and the age of flight was ushered in. The discovery of the telephone, the wireless telegraph and the wireless telephone would either of them have been of sufficient moment to give a name to a new epoch had they only been separated by sufficiently long intervals.

So it has been with the emancipation of woman. So-called "female seminaries" were followed shortly by women's colleges, and by coeducation in the liberal arts colleges of our universities. Finally the professional schools opened wide their doors, and we became accustomed to women lawyers, doctors, and engineers. The great world war disclosed the fact that there was one occupation essentially masculine, but the departure to France of some two million or more of our male population as fighters spelled Opportunity with a capital O for the daughters of men, and we have now become familiar with women munitions workers, women street-car conductors, women elevator "boys," and women messenger "boys."

Certainly we are living in an age of rapid

[1] Address to the graduating class of the School of Horticulture for Women, Ambler, Pa., December 13, 1918.

progress, and the oldest and most fundamental of all human pursuits—the cultivation of the soil—has not remained untouched. Just as agriculture is one of the oldest occupations of man, so, also, is it one of the oldest occupations of women. It was part of the business of the Indian squaw to scratch up the earth and plant and cultivate corn, while her lord and master was busy in the so-called "larger sphere" outside the home. We recall, with no particular feeling of pride in our species, the fact that in some countries women, as a matter of general practise, were yoked with the oxen in plowing. One particularly militant woman of my acquaintance has remarked that this lot was preferable to being yoked for life to the owner of the oxen!

But every concession is dangerous, unless one is prepared to go the entire logical length of the course. The modern man knows this only too well. Freedom of action outside the four walls of the home is a wonderfully broadening process, for woman as well as for man. If I can pull the plow with the ox, why might I not plan and supervise the work, and even own the ox, and the plow, and the farm? Nothing is more unsettling than questions unanswered; nothing is more enlightening than the pursuit of the answer; nothing is more convincing than the particular answer one very much wishes to find. Why, indeed?

The history of the intervening steps and struggles and advances is too long to be here reviewed, but we are all familiar with the results—the bill of rights, the declaration of independence, the emancipation proclamation, equal suffrage, and a seat in Congress. So I find myself, this afternoon, addressing the graduates of a school of horticulture for women.

In that charming forerunner of our modern popular books on gardening, "My Summer in a Garden," Charles Dudley Warner makes the unguarded statement that "Women always did, from the first, make a muss in a garden." This poorly concealed reference to Eve and Eden was a mean fling, and I found myself saying, as I read it, that, if Charles Dudley Warner had been writing in 1918, he would have been more circumspect in his statements—especially if he had any thought of running for public office. But as I read on, I found that his wisdom and judgment had not wholly forsaken him, for he continues:

> But I am not an alarmist . . . I am quite ready to say to Polly or to any other woman, "You can have the ballot; only leave me the vegetables." . . . But, I see how it is. Woman is now supreme in the house. She already stretches out her hand to grasp the garden. She will gradually control everything. . . . "Let me raise the vegetables of a nation," says Polly, "and I care not who makes its politics."

Here we have an inspiration to return to the *modus vivendi* of the red Indian. In biology we would call it atavism; it is always an indication that progress has taken place.

But there is another and more serious reason why Charles Dudley Warner would have written otherwise to-day. He, and his contemporaries had probably never heard of a school of horticulture *for women.* Now schools of horticulture for women exist for the express purpose of educating women so that they shall not make a muss in the garden—just as law and medical schools exist so that men and women shall not "make a muss" in law and medicine—just as schools of horticulture for men aim to prevent men from making a muss in a garden—in other words, to make horticulture a profession, and not merely an occupation. This is the theme which I wish briefly to elaborate and emphasize this afternoon—*horticulture a profession.*

Superficially we all know the difference between a trade and a profession. For ex-

ample, one holds a position, not a job; he is employed by the month or year, not by the day; he earns a salary, not wages. But these are all superficial differences. There are other distinctions, significant, fundamental. May I speak briefly of two of them?

First, The Nature of the Preparation Required.—One may learn how to raise vegetables and flowers with success by beginning as gardener's helper, imitating the experienced practitioner, substituting in his absence, and thus gradually acquiring sufficient skill to proceed independently, and, in turn, pass on his information and skill to other apprentices. But, with rare exceptions, what the journeyman has learned, is all that he can pass on; like father, like son. But where is the opportunity for progress here? The history of agriculture in China, or Palestine, or with our own aborigines, gives the clear answer. There is little or no opportunity for progress. Cloth would be spun on hand looms to-day had no other factor been introduced into spinning than the instruction of daughters by mothers. This kind of instruction does not make for progress; it can never convert a trade into a profession. The spinning jenny was not invented by a spinner, nor the wireless telegraph by a telegraph operator, nor the science of agronomy by practical farmers.

Progress depends upon a fullness of preparation exceeding the limits of anticipated requirement in practise. This is why I have never liked the phrase, "teachers *training* class." Horses may be trained, and a well-trained horse may be depended on to do accurately and promptly the tricks that are taught him. But place him in a new situation, or confront him with a new problem, or an old one somewhat altered—and you may then learn clearly and easily the difference between training and education.

In order to become a horticulturist, as distinguished from a practical gardener, one's knowledge must exceed the anticipated demands upon it in practise. He must not only know how and when to cultivate, but why; not only the names of his plants, but the nature of plants—why leaves are green, what flowers are for, how seeds are formed, how roots absorb moisture, how plants feed, the nature of plant diseases (as well as when and how to spray), the nature and kinds of variation, the basis of selection, why some varieties tend to run out, why corn "mixes in the hill." This is the knowledge that gives power, this is the basis of progress. I do not mean that such fullness of knowledge is always necessary in order to raise good crops—to be a good gardener; but it is necesary in order to be able still to raise good crops in spite of unforeseen obstacles—the new insect or fungus pest, an excessive drought, a season of unusual weather in general; it is necessary in order to raise increasingly better crops, in order to introduce improvements in practise, in order to become a horticulturist.

Horticulture is an art, and like all arts, it is based upon certain sciences; a knowledge of these fundamental sciences is necessary—soil technology, economic entomology, the elements of botany, with special emphasis on plant physiology; something of plant pathology, the principles of plant breeding, ecology or the relation of plants to their environment; something of physics and chemistry, plant geography, and the history of cultivated plants. Moreover one should know the history of his profession, be acquainted with the classic publications, the names and lives of the founders and leading horticulturists. One can never keep abreast of the times (let alone becoming a leader) who does not keep in touch with the new and modern books, and the current periodical literature of the subject.

Membership in local and national organizations of gardeners or horticulturists is stimulating, if not essential.

And finally, one should have a hobby—one or more. Nothing is more narrowing than exclusive attention to one life-interest; nothing is more fatal to the best accomplishment; nothing so dwarfs one's soul. Years ago President Eliot, of Harvard University, tersely defined a liberal education as, "Everything of something and something of everything." The latter is almost, if not quite, as important as the former. Be horticulturists, or gardeners, or teachers of horticulture, but do not be *merely* horticulturists or teachers. Never lose sight of the fact that you are women first, horticulturists second, and that the largest success in one's lifework is quite as much a matter of breadth as of depth, of character as skill.

The second and last distinction I wish to emphasize between a trade and a profession is the personal attitude toward one's work. Why did you attend a school of horticulture? Why did you ever think you wanted to make some phase of gardening your life work? *Do you think so now,* after you have had a taste of it, or do you feel that you might, after all, be happier in some other occupation? These are vital questions; on the answers you can give to them depend your success or failure, if you persist in following the occupation for which you have been fitting yourself in this institution.

There is an occupation of gardening; there is a profession of horticulture. As I have stated above, in practise horticulture is an art; in theory it is an applied science, having a body of literature of its own, raised in its pursuit above the trammels of empiricism, yielding contributions to its own progress from within. Of all this you should aspire to be a part, not only making yourselves familiar with the literature, but contributing thereto; not only basing your own practise on wide knowledge of fundamentals, instead of on rule of thumb, but seeking to ascertain for yourselves new principles, or new applications of old principles; not only keeping abreast of progress, but endeavoring to contribute something substantial thereto—in some small degree, at least, to be leaders.

A friend of mine, a college professor, spending a summer in New York City, rented the furnished apartment of a teacher in one of the city high schools. After he had occupied the apartment for three or four weeks he asked me if I knew what subject the high school teacher taught. I replied that I did not, but inquired whether the answer to his question might not be found in the titles to the books and magazines in the apartment. To my surprise, and to his, no such incriminating evidence could be found. So far as anything about his home might suggest, he might have been a clerk or a bookkeeper, as well as a teacher. In view of what we have been saying, the significance of this is self-evident. To all appearances, this teacher of youth possessed no library of books, and subscribed for no magazines bearing on his own calling; are we not justified in concluding that his real interests were outside the pale of his daily occupation and his chosen life work. I was sorry for him; I was still more sorry for the pupils who were obliged to sit daily under his perfunctory instruction.

What I plead for is that you shall not view the vocation of horticulture *merely* as a means of earning a living or raising plants, or the avocation of horticulture merely as a means to planting your own garden or decorating your own home grounds. Food is good and we must have it; beauty is good and we must also have it. Objects of beauty are as necessary as food to right, complete living; but you can get

more than this, even, out of the study and practise of horticulture. The dignity and worth of the human spirit is a greater good, to which all else should be made to minister.

You are graduates of a technical school. There are some who go to a technical school with no other idea than to secure training for a profession; there are indeed some who contend that technical schools are necessarily limited in their work to preparation for a vocation, and this is the danger. At about the middle of the nineteenth century the controversy was rife in England as to whether professional studies had any place in a university. Cardinal Newman argued, with all the power of his eloquence, that it is the purpose of a university to confer, not a technical, but a *liberal* education; and he defined a liberal education as consisting in the culture of the intellect for its own sake, without reference to utilitarian ends.

One can hardly overestimate the value of a liberal education, thus defined, for all, no matter what their calling in life. Every one, whether horticulturist or doctor, or lawyer or engineer—whatever his vocation—must take his place in a community of individuals of varying degrees of culture, of other interests than his own, of broad as well as of narrow outlook, and he can not do it successfully by being merely a horticulturist, or a lawyer. The position he can take, the influence for good he can yield, will depend upon his own expansion of mind, the width of his own sympathies, the breadth of his own culture.

A recent editorial in a New York daily paper called attention to the fact that the French educational mission of seven savants, now in this country, contained but one scientist, and expressed great satisfaction at this fact, as indicating the contrast between French and German culture, of the latter of which we have had enough—*ad nauseam*. But the repugnant and unsavory character of German culture is not to be attributed to the extensive development of scientific studies in Germany, but to the fact that her entire educational system, in the schools and out, has been permeated with an antiquated, unchristian, inhuman, abhorrent system of ethics and morality. She was rotten at the heart.

I wish to emphasize the point that liberal education is not necessarily a matter of content—of non-utilitarian subjects—but of spirit and of methods. The studies of Greek, Latin and Hebrew were at first introduced into university instruction for utilitarian purposes, but soon became the foundation stones of a liberal education. The studies of medicine, law, theology, engineering, botany, horticulture, may be pursued in such a way as to produce *merely* doctors, lawyers, divines, engineers, botanists, horticulturists; or they may be pursued with a spirit and method that will produce, as well, men and women of broad culture—of liberal education, more competent in their professions, more creditable and satisfactory to themselves, more valuable in their communities. Make your horticultural study, then, not only a means of preparation for a vocation, but also a basis and means of education—of the enlargement of your minds, the enrichment of your lives, the expansion and perfection of your characters.

You are entering upon a noble calling. The outstanding names in horticulture—Vilmorin (father and son) and Lemoine in France, Thomas Andrew Knight, Veitch and Sutton in England, Robert Fortune in Scotland, Van Tubergen and de Vries in Holland, Correvon in Switzerland, Henderson, Meehan, Bailey, and others in America, would do honor to any profession. You have a reputation to maintain, and an obligation to maintain it.

Moreover, horticulture is one of the later and therefore, one of the finer fruits of civilization. "When ages grow to civility and elegancy," says Lord Bacon, in his essay on gardens, "men come to build stately sooner than to garden finely; as if gardening were the greater perfection." The domestication and cultivation of plants is intimately bound up with the time when men, hitherto accustomed to roam, and to depend upon a chance supply of food from wild plants and animals, first began to take up permanent abodes in communities, and therefore found it, not only convenient, but essential to have a local supply insured; yet from all we can learn of the most ancient civilizations, there were no gardens as we now know them. Culinary vegetables, for example, were raised in ancient Egypt, as we learn from inscriptions on the pyramid of Cheops, and from other sources; but while accounts of the splendor of Memphis speak of statues, temples, and palaces, no mention is anywhere made of gardens.

In his letter to Gallus, describing his Laurentian estate,[2] Pliny's mind is chiefly occupied with the details of his villa, and while he refers to his tennis court, to an exercise ground with a border of boxwood and rosemary, and to "a terrace walk that is fragrant with violets," mention of his garden seems quite incidental, and all we learn of it is that it "is clad with a number of mulberry and fig-trees"; in other words it does not appear to be a garden, as we understand the term, nor to loom large in the mind of its owner as one of the chief attractions of his summer home.

Even as late as the middle of the eighteenth century Horace Walpole said (in a letter to Conway), "I lament living in so barbarous an age, when we are come to so little perfection in gardening." But gardens and the domestication and cultivation of plants, were the inevitable, logical sequence of the establishment of homes and gradually they make their appearance and begin their evolution as one of the finer expressions of civilization.

"Happy is the man who loves flowers," wrote Henry Ward Beecher, and in pleading for more effective writing in American horticultural magazines, he referred to horticulture as "this elegant department of knowledge." Not only may the study of the science itself become an avenue of culture and refinement, but a study of its origins (as a phase of agriculture), and of its historical development leads into some of the most fascinating and illuminating chapters in the history of civilization. If the artificial production of fire is conceded to be one of the greatest steps forward in the intellectual ascent of man, the domestication of wild animals and plants is second only in importance, and the historical study of this wonderful achievement has ramifications that carry one back to the very dawn of civilization, and laterally into enriching contact with archeology, ethnology, geology, plant geography, ancient and modern history, evolution, philosophy and other departments of knowledge.

We know that some of our economic plants were cultivated by the lake-dwellers of Switzerland while they were yet in the neolithic stage of culture, some three thousand years or more before the Christian Era. "Farmers of Forty Centuries" is the fascinating title of Professor King's study of the agriculture of China; that is, some of our cultivated plants—a date or a grain of rice—represent an unbroken line of living protoplasm, and of human aspiration and upward struggle, extending back some 5,000 or 6,000 years. Like any department of human knowledge, the study of horticulture, thoroughly pursued in all its vari-

[2] "Letters," 1st Ser., Bk. 2, Letter XVII.

ous aspects, may become the inspiration and means of a liberal education.

It is probable that the immediate future will offer unusual opportunities in horticulture as in all other fields of worth while human endeavor. The restoration of devastated Europe will not be complete until it includes the esthetic as well as the merely utilitarian. Already the call has come to this country for trained gardeners, for the Hun's conception of the exigencies of war has included the wholesale destruction of trees, parks, orchards and gardens. It is worthy of mention at this time and place that the American Horticultural Society has already collected and forwarded to France the sum of several thousand dollars to be expended in the replacing of ruined fruit trees and orchards.

The need here at home has never been greater. The truth of Lord Bacon's statement has found abundant confirmation in America, for, notwithstanding the early introduction of nurseries and horticulture in the colonies—notably by the Princes, father, son and grandson, on Long Island (1725 and later), by Bartram (1728), Evans and Humphrey Marshall near Philadelphia, by Andrew Jackson Downing ("perhaps the fairest name in American horticultural literature"), by David Hosack (1801) in New York, by M'Mahon (1800), Bloodgood (1820), Hogg (1834), Parsons (1838), Landreth (1874), Thorburn (1802), and a host of other pioneers—notwithstanding these early labors, subsequent development has been slow. But we have now passed the pioneer stage of national development, and the conditions which, for a time, justified our shortcomings in esthetics have ceased to exist; the forests are cleared, the frontier has vanished, mud huts and log cabins (mere houses) have given place to real homes. We have even managed to survive the periods of mansard roofs and brown stone fronts, and our villages and cities have already begun to recognize the value of horticulture and landscape gardening in making centers of business places of beauty as well.

See your vocation, then, in broad perspective—in its relation to the sum total of things; to social needs, spiritual needs, civic needs, human needs—the development of your own character, of a more refined and cultured national character. We are living in one of the most, if not the most momentous period in human history. It is a wonderful privilege to be alive now—to be a part of all that is transpiring, to be entering now upon one's life work. Never has there been a greater need for the best in all things. The self-revelation of the unspeakable Hun has left us with a feeling of disgust, as if we had been in contact with something base and unclean, as indeed we have; and the need was never so urgent as now for an increase of knowledge and the wide diffusion of truth and of spiritual and material beauty. It is your function and privilege to cooperate with the architect, the landscape architect, the town planner, in making beautiful the habitations of men.

There are those to-day who are crying aloud in the land that the work before us of educational reconstruction shall be characterized by making everything primarily or even exclusively "practical"—by choosing our studies and placing our emphasis chiefly with reference to bread-and-butter considerations. This is the great danger ahead of us in our program of education; it is quite as unfortunate to lose sight of the ideal as to forget the material needs of life. A Brooklyn divine has tersely said that, in hitching his wagon to a star, the idealist has chiefly in mind the star, while the administrator—the man of affairs—has chiefly in mind the wagon. Hitch your wagon to a

star, by all means, in horticulture, but do not lose sight of either the wagon or the star.

Are you really interested in this work—in some phase of horticulture? If you are not, I commiserate you on the time you have spent at this school; if you are, I am glad to extend to you the most hearty congratulations and good wishes on the completion of your course here, and the commencement of the larger and more serious work upon which you are about to enter.

C. Stuart Gager

Brooklyn Botanic Garden

LETTER ON THE SMITHSONIAN INSTITUTION[1]

BY THE LATE PROFESSOR LOUIS AGASSIZ

Addressed to the Honorable Charles W. Upham

Dear Sir,—Every scientific man in this country has been watching with intense interest the proceedings of the Smithsonian Institution ever since its foundation, satisfied, as all must be, that upon its prosperity the progress of science in America in a very great measure depends. The controversies which have been lately carried on respecting the management of the institution have increased the solicitude of its friends with regard to its future prospects in a degree which can hardly be realized by those who are not immediately connected with the cause of science.

As a foreigner, who has enjoyed but for a few years the privilege of adding his small share to support the powerful impulse which scientific investigations have lately received from those who are the native representatives of science in America, I have thus far abstained from taking any part in this discussion, for fear of being charged with meddling with matters in which I have no concern. There is, however, one feature of the institution itself, which may, I trust, justify the step I have taken in addressing you upon this subject as the chairman of the committee elected by the House of Representatives to investigate the proceedings of that establishment.

With the exception of a few indirect allusions, I do not see that any reference is made in the discussion now going on to the indisputable fact that the Smithsonian Institution is not an American institution. It was originated by the liberality of a high-minded English gentleman, intrusting his fortune to the United States to found in Washington an institution *to increase and diffuse knowledge among men.* America, in accepting the trust, has obtained the exclusive management of the most important and the most richly endowed scientific institution in the world: but it is at the same time responsible to the scientific world at large for the successful prosecution of the object of the trust, which is to *increase* and *diffuse* knowledge among men.

Were it not for this universal character of the institution, I would not think it becoming in me to offer any suggestion with regard to it. As it is, I feel a double interest in its prosperity—in the first place, as an institution designed to foster the process of science at large, and without reference to nationalities or local interests, and next, as more immediately connected with the advancement of science in the country of my adoption.

The votaries of science may differ in their views about the best means of advancing science, according to the progress they have themselves made in its prosecution; but there is one standard of appreciation which can not fail to guide rightly those who would form a candid opinion about it. I mean the lives of those who have most extensively contributed in enlarging the boundaries of knowledge.

There are two individuals who may, without qualification, be considered the most prominent scientific men of the nineteenth century—Cuvier and Humboldt. By what means have they given such powerful impulse to science? How have they succeeded not only in increasing the amount of knowledge of their age, but also in founding new branches of science? It is by their own publications and by aiding

[1] From *Canadian Journal,* Vol. III., 1854 and 1855, pp. 216–217, in the April number for 1855. containing Proceedings of the Canadian Institute. Communicated by Dr. Otto Klotz, Dominion Observatory, Ottawa, Canada.

in the publications of others; by making large collections of specimens and other scientific apparatus, and not by the accumulation of large libraries. Humboldt never owned a book, *not even a copy of his own works,* as I know from his own lips. "He was too poor," he once said to me, "to secure a copy of them"; and all the works he receives constantly from his scientific friends are distributed by him to needy students.

Again, there is hardly a scientific man living on the continent of Europe, who is not indebted to him for some recommendations in the proper quarter for assistance in the publication of their works. I mention more particularly these details about Humboldt, because he is happily still among the living, and his testimony may be asked in a matter of such deep importance to the real progress of science. But the same is equally true of the part Cuvier took in his day in promoting science. All his efforts were constantly turned towards increasing the collection of the *Jardin des Plantes,* and supporting the publication of original researches, giving himself the example of the most untiring activity in publishing his own.

In this connection, I ought not to omit mentioning a circumstance to which the United States owes the legacy of Smithson, which I happen accidentally to know, and which is much to the point, in reference to the controversy concerning the management of the Smithsonian Institution.

Smithson had already made his will, and left his fortune to the Royal Society of London, when certain scientific papers were offered to that learned body for publication. Notwithstanding his efforts to have them published in their transactions, they were refused; upon which he changed his will and made his bequest to the United States. It would be easy to collect in London more minute information upon this occurrence and, should it appear desirable, I think I could put the committee in the way of learning all the circumstances. Nothing seems to me to indicate more plainly what were the testator's views respecting the best means of promoting science than this fact.

I will not deny the great importance of libraries, and no one has felt more keenly the want of an extensive scientific library than I since I have been in the United States; but, after all, libraries are only tools of a secondary value to those who are really endowed by nature with the power of making original researches, and thus increasing knowledge among men. And though the absence or deficiency of libraries is nowhere so deeply felt as in America, the application of the funds of the Smithsonian Institution to the formation of a library, *beyond the requirements of the daily progress of science,* would only be, in my humble opinion a perversion of the real object of the trust, inasmuch as it would tend to secure facilities only to the comparatively small number of American students who may have the time and means to visit Washington when they wish to consult a library. Such an application of the funds would in fact lessen the ability of the Smithsonian Institution to accomplish its great object (which is declared by its founder to be the increase and diffusion of knowledge among men) to the full extent to which they may be spent towards increasing unduly the library.

Moreover, American students have a just claim upon their own country for such local facilities as the accumulation of books affords.

If I am allowed, in conclusion, to state my personal impression respecting the management of the institution thus far, I would only express my concurrence with the plan of active operations adopted by the regents, which has led to the publication of a series of volumes, equal in scientific value to any production of the same kind issued by learned societies anywhere.

The distribution of the Smithsonian Contributions to Knowledge has already carried the name of the Institution to all parts of the civilized world, and conveyed with them such evidence of the intellectual activity of America as challenges everywhere admiration: a result which could hardly be obtained by applying the resources of the institution to other purposes.

SCIENTIFIC EVENTS

CHARLES LEANDER DOOLITTLE

As an expression of sorrow over the death of Professor Charles L. Doolittle, the college faculty of the University of Pennsylvania recently passed the following resolutions:

The college faculty learns with profound grief of the death of their colleague, Professor Charles Leander Doolittle, who has been associated with them since 1895, at first as professor of mathematics and astronomy, and since 1899, when these departments were separated, as professor of astronomy, until his retirement from active duty in 1912.

Professor Doolittle's position in the world of astronomy was a distinguished one, and not only this university but the scientific world at large has by his death sustained a great loss.

As a colleague, Professor Doolittle was ever ready to bear his part in helping to solve the perplexing problems which naturally arise in conducting the affairs of a great university, and by his wisdom to assist in reaching such conclusions as would further the best interests of students and institution.

In deploring the loss of a helpful counsellor and a genial friend, the members of the college faculty desire to extend to Professor Doolittle's family their sincere sympathy. They also direct that this record of their action be entered on the minutes and that it be inserted in the appropriate university publications.

Edwin S. Crawley,
Henry Brown Evans,
Samuel G. Barton,
Committee of the College Faculty

AIRPLANE FUEL

During the war the Bureau of Mines, Department of the Interior, made strenuous efforts to find a special fuel for airplanes that would be superior to others already in use. Of the numerous products and mixtures obtained some were originated by the bureau engineers and chemists, others were suggestions by outside interests. Through its own experiments or by cooperation with other organizations, notably the research division of the Dayton Metal Products Co., and the Bureau of Standards, it was possible to establish the fact that certain types of fuels had elements of superiority that had not before been noted or appreciated. Of the fuels proving most satisfactory, gasoline refined from the crude petroleum of certain producing fields was distinctly superior to the type most extensively used. The blending of moderate proportions of benzol with gasoline was found to be distinctly advantageous, and motor fuel of this type would undoubtedly have been employed for military purposes if the war had continued much longer. It is believed that through the proper use of benzol and other distillates derived from coal it may be possible to embody features in the design of internal combustion motors that will notably increase their efficiency. Benzol and other coal-derived fuels are already being sold for use in automobiles and are believed to be giving satisfactory results even with present types of motors.

The bureau was particularly interested in a special fuel tested in cooperation with the Dayton organization and named "hector." This fuel, which was a mixture of cyclohexane, and benzol, gave indications of marked superiority over any other product tested and should, unless unforeseen deficiencies appear, prove ideal for the military aviation service. In some experimental flights this fuel has given 10 miles an hour more speed. It is not certain that the cost of production will ever be low enough to permit its use in peace times, but it is planned to complete the work of obtaining comprehensive information regarding all of its possibilities and to publish reports on the subject in cooperation with the engineers of the research division of the Dayton Metal Products Co.

NATIONAL RESEARCH FELLOWSHIPS IN PHYSICS AND CHEMISTRY SUPPORTED BY THE ROCKEFELLER FOUNDATION

The National Research Council has been entrusted by the Rockefeller Foundation with the expenditure of an appropriation of $500,000 within a period of five years for promoting fundamental research in physics and chemistry in educational institutions in the United States.

The primary feature of the project is the

initiation and maintenance of a system of National Research Fellowships, which are to be awarded by the National Research Council to persons who have demonstrated a high order of ability in research, for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for effective prosecution of research in physics or chemistry. The plan will include such supplementary features as may promote the broad purpose of the project and increase its efficiency.

Among the important results which are expected to follow from the execution of the plan may be mentioned:

1. Opening of a scientific career to a larger number of able investigators and their more thorough training in research, thus meeting an urgent need of our universities and industries.

2. Increase of knowledge in regard to the fundamental principles of physics and chemistry, upon which the progress of all the sciences and the development of industry depend.

3. Creation of more favorable conditions for research in the educational institutions of this country.

The project will be administered by the research fellowship board of the National Research Council. This board consists of six members appointed for terms of five years and of the chairmen *ex officio* of the Division of Physical Science and the Division of Chemistry and Chemical Technology of the National Research Council. The members of the board are:

Henry A. Bumstead, professor of physics, Yale University.

Simon Flexner, director of the Laboratories of the Rockefeller Institute for Medical Research.

George E. Hale, director of Mount Wilson Observatory.

Elmer P. Kohler, professor of chemistry, Harvard University.

Robert A. Millikan, professor of physics, University of Chicago.

Arthur A. Noyes, director of the Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology.

Wilder D. Bancroft, professor of physical chemistry, Cornell University, chairman of the Division of Chemistry and Chemical Technology.

——— — ———, chairman of the Division of Physical Science.

The appointments of national research fellows will be made only after careful consideration of the scientific attainments of all candidates, not only of those who apply on their own initiative, but also of those who are brought to the attention of the research fellowship board by professors in educational institutions and by other investigators throughout the country.

The research fellowships will for the most part be awarded to persons who have had training at an American university or scientific school equivalent to that represented by the doctor's degree. The salary will ordinarily be $1,500 for the first year. The research fellowship board will not, however, be bound by rigid rules of procedure. Thus it may offer larger salaries to those of exceptional attainment or wider experience, and may give appointments to competent investigators who have had training other than that represented by the doctor's degree.

The research fellows will be appointed for one year; but they will be eligible for successive reappointments, ordinarily with increases of salary.

It is expected that fifteen to twenty research fellowships will be available during the coming year, and that the number will be increased in subsequent years.

Applications for the fellowships should be made on the form provided for the purpose, and should be sent to the secretary of the research fellowship board, National Research Council, 1023 Sixteenth Street, Washington, D. C. Applications will be received up to September 1, 1919, for fellowships available during the next academic year; but a limited number of appointments will be made on the basis of the applications received before April 20, 1919.

SCIENTIFIC NOTES AND NEWS

COLONEL E. LESTER JONES, after service in the Army for about a year in America and France has returned to his duties as head of the Coast and Geodetic Survey.

Lieutenant Colonel William McPherson, who entered the services of the War Department shortly after the declaration of war by the United States, has secured his discharge and has returned to his former position as head of the department of chemistry at the Ohio State University.

Professor Clough T. Burnett, professor of bacteriology in the University of Colorado, has returned from France, where he was the head of the commission for the prevention of tuberculosis.

Dr. H. C. Taylor, head of the department of agricultural economics in the college of agriculture, University of Wisconsin, has been appointed by the Secretary of Agriculture as chief of the Office of Farm Management. Francis W. Peck, of the University of Minnesota, has been appointed to the position of farm economist in the office.

The *Proceedings* of the Washington Academy of Sciences state that the following members of the Chemical Warfare Service have joined the staff of the Bureau of Standards since January: Captain J. M. Braham, in the electrochemical laboratory; Lieutenant C. W. Clifford, sugar laboratory; S. C. Langdon, electrochemical laboratory; F. W. Reynolds (formerly at Edgewood Arsenal), laboratory of metallurgical chemistry; P. Wrightsman, gas laboratory. Mr. J. R. Eckman, formerly of the Ordnance Department, has joined the staff of the bureau as chemist in the analytical laboratory; Mr. W. B. Newkirk, formerly with the Oxnard Sugar Company, as sugar technologist, and Mr. A. A. Benedict, formerly of of the University of Pittsburgh, as physicist in the sugar laboratory.

Professor W. B. Meldrum, formerly head of the department of chemistry at Haverford College and later in the Chemical Warfare Service on duty at the American University Experiment Station, has accepted a temporary position as chemical expert with the Price Section of the War Industries Board.

Dr. William T. Brigham, Sc.D., in charge of the Bernice Pauahi Bishop Museum, Honolulu, since its foundation, has resigned the directorship and the trustees have conferred upon him the title of director emeritus. Dr. Brigham continues his connection with the museum as curator of anthropology.

The Adams prize, value £250, has been awarded by the University of Cambridge, to Professor J. W. Nicholson, professor of mathematics at King's College, University of London.

A meeting of Unionists has been held at Oxford to consider the selection of a candidate to fill the vacancy in the representation in Parliament of the university caused by the elevation of Mr. R. E. Prothero to the peerage. It was decided to invite Mr. David G. Hogarth, fellow of Magdalen College, archeological explorer, geographer and author, to become the candidate. Mr. Hogarth is at present in Egypt.

Professor Alan M. Bateman, of the department of economic geology, Yale University, has been elected editor of the *Journal of Economic Geology.*

Dr. Graham Edgar, formerly secretary of the Washington office of the Research Information Service, National Research Council, has resigned and is now with the Nitrate Division of the Ordnance Department of the Army. Mr. Gordon S. Fulcher is his successor as secretary of the Information Service.

Dr. Walter M. Mitchell, recently manager of inspection for the Bureau of Aircraft Production, U. S. War Department, in Rochester, N. Y., has been appointed director of the metallurgical and testing laboratory, Standard Roller Bearing Co., Philadelphia, Pa.

Dr. C. S. Hudson, chief of the carbohydrate laboratory of the Bureau of Chemistry, has resigned to accept a position with the Samuel Heath Company, of Trenton, N. J.

At a joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington on March 15, Dr. H. D. Curtis, of the Lick Observatory, delivered an address on "Modern theories of spiral nebulæ."

Lieutenant Colonel John R. Murlin, U. S. A., of the Surgeon General's Office, gave an

address on "Food efficiency in the United States Army" before the Washington Academy of Sciences on March 20.

At the annual joint meeting of the Alabama Technical Association (Alabama Sections of the A. S. C. E., A. S. M. E., A. S. E. E. and A. C. S.), held in Birmingham on March 1, Professor Isaac Newton Kugelmass addressed the conference on "The relations of chemistry to modern laundering and its field for research in the economic service of man."

Major R. M. Yerkes, of the Office of the Surgeon General of the Army, delivered an illustrated lecture before the District of Columbia Chapter of the Sigma Xi on the subject, "The relationship of the army mental tests to education and vocational guidance" on March 6.

Dr. J. McKeen Cattell gave, on March 20, the address before the Syracuse University chapter of Phi Kappa Phi, the subject being "Science and civilization."

Lectures recently given at the Royal Institution, London, include the following: Sir Oliver Lodge on "Ether and Matter"; Captain G. P. Thomson two lectures on "Aeroplanes in the Great War"; Professor H. M. Lefroy two lectures on "Insect Enemies of Our Food Supplies" and on "How Silk is Grown and Made"; Mr. A. T. Hare on "Clock Escapements."

A committee has been formed to raise an endowment fund of $100,000 to perpetuate the method of after care for maternity cases evolved by the late Dr. Edwin Bradford Cragin, of the College of Physicians and Surgeons, Columbia University, in connection with the work of the Sloane Hospital for Women.

Dr. Herbert Huntington Smith, curator at the museum of the University of Alabama, was killed on March 22 by a train. Dr. Smith, known for his work in entomology and on mollusca, was born at Manlius, N. Y., in 1851.

Elizabeth Letson Bryan, wife of Professor William Alanson Bryan, of the College of Hawaii, died on February 28, aged forty-four years. Dr. Bryan before her marriage was director of the Museum of the Buffalo Society of Natural Science and was known for her contributions to conchology.

On account of the disturbed conditions of transportation, etc., the session of the Twentieth International Congress of Americanists has been postponed until June, 1920.

Joseph and John W. Mailliard, prominent business men of San Francisco and well-known students of American birds, have donated their entire ornithological and oological collections to the Museum of the California Academy of Sciences. These collections contain more than 11,000 birds and over 13,000 specimens of nests and eggs, representing nearly 800 species. Joseph Mailliard has accepted the position of honorary curator, department of ornithology, in the museum of the academy.

The trustees of the British Museum have had presented to them a valuable collection of ancient British coins by Sir Arthur Evans, to whom they were bequeathed by his father, Sir John Evans, the distinguished archeologist. Sir John Evans, in 1864 wrote an important book on "The Coins of Ancient Britain."

The Puget Sound Biological Station at Friday Harbor, Washington, will open on June 16, 1919, its sixteenth annual session, which is to continue for six weeks. The station will be open to independent workers until October; and as early as June 1, if arrangements are made with the director. The earlier part of the season is the best for embryological work. Tents and research rooms may be reserved by writing the director, T. C. Frye, University of Washington, Seattle.

In the act making appropriation for the legislative, executive and judicial expenses of the government for the fiscal year ending June 30, 1920, there is provision for increased compensation amounting to $240 per annum for all employees holding regular appointments in the Bureau of Fisheries now receiving $2,500 or less. This increase becomes effective on July 1, 1919, and is in lieu of the existing increase of $120 per annum.

The following letter addressed by the editor of Science to M. George Sarton at Wondelgem-

lez-gand, Belgium, on January 22, 1915, was delivered to him at Cambridge, Mass., on March 10, 1919.

You may be interested in a letter which Professor Smith has, at my suggestion, written for SCIENCE. I greatly admire your courage in continuing *Isis* under the lamentable conditions now existing. The journal is of such high standards that its discontinuance would be a serious loss to science. The publication department of *The Popular Science Monthly* has handed me the enclosed letter and the writer has been informed that it will be forwarded to you.

The printing of the letter may serve to call attention to the fact that the publication of *Isis* has now been resumed under the editorship of M. Sarton.

THE National Forest Reservation Commission has approved for purchase 54,744 acres of land for national forests in the White Mountains, Southern Appalachians and Arkansas. The largest tracts purchased are in Georgia, where the resumption of purchase work has been authorized by the commission. An aggregate area of 38,108 acres in Rabun, Union and Townes counties, scattered through thirty-nine tracts, was approved for purchase at an average price of $7,22 per acre. In Alabama, in Lawrence and Winston counties, 5,159 acres were approved at an average price of $4.30; in North Carolina, in Macon and Buncombe counties, 1,940 acres were approved at an average price of $4.30 an acre; in Virginia, in Augusta and Shenandoah counties, 1,381 acres were approved at an average price of $4.36 an acre in West Virginia, in Hardy county, 40 acres at an average price of $7 an acre; and in New Hampshire, in Grafton and Coos counties, 9.04 acres at an average price of $6.68 an acre. In Arkansas, 7,269 acres, located mainly in Polk, Pope, Johnson and Garland counties, were approved for purchase at an average price of $3.61 per acre. To date the National Forest Reservation Commission has approved for purchase 1,702,534 acres for national forest purposes in the seventeen areas of eastern national forests.

Nature states that with the view of meeting the growing demand for technical literature, the council of the Chemical Society decided early in 1917 to increase the scope of the library of the society by a more liberal provision of suitable technical works and journals It was also thought that by placing the existing library of 23,000 volumes and the proposed extension at the disposal of members of other societies and associations they might relieve themselves of the necessity of collecting and maintaining the literature relating to their special subjects, and assist in the formation of a representative library of chemical literature, such as would be difficult to obtain by individual effort. A conference of representatives of societies and associations connected with chemical science and industry was held to consider the means by which other societies, etc., might cooperate in this extension, and financial assistance was afterwards offered by the following societies, etc.: Association of British Chemical Manufacturers, Biochemical Society, Faraday Society, Institute of Chemistry, Society of Dyers and Colorists, and Society of Public Analysts. Members of these contributing societies, etc., will be permitted to consult the library and borrow books.

THE Royal Institution, London, arranged a Christmas course of juvenile lectures which were delivered by Professor D'Arcy Thompson on "The Fish of the Sea," beginning on December 31 at 3 o'clock. The following courses of lectures are included in its program: Professor Spenser Wilkinson, "Lessons of the War"; Professor MacGregor-Morris, "Study of Electric Arcs and their Applications"; Captain G. P. Thomson, "The Development of Aeroplanes in the Great War and The Dynamics of Flying"; Professor Hele-Shaw, "Clutches"; Professor Arthur Keith, "British Ethnology: The People of Scotland"; Professor Norman Collie, "Chemical Studies of Oriental Porcelain"; Dr. W. Wilson, "The Movements of the Sun, Earth and Moon"; Professor H. M. Lefroy, "Insect Enemies of our Food Supplies and How Silk is Grown and Made"; Professor C. H. Lees, "Fire Cracks and the Forces Producing Them"; Professor

A. Findlay, "Colloidal Matter and its Properties"; and Sir J. J. Thomson, "Spectrum Analysis and its Application to Atomic Structure." The Faraday discourses began on January 17, when Sir James Dewar gave a lecture on "Liquid Air and the War"; and other discourses were announced by the following gentlement: Lieutenant Colonel A. Balfour, Professor H. H. Turner, Professor J. G. Adami, Professor C. G. Knott, Mr. A. T. Hare, Professor J. A. McClelland, Professor H C. H. Carpenter, Professor A. Keith, Professor W. W. Watts, Sir John H. A. Macdonald and Sir J. J. Thomson.

THE United States nitrate plants were built with the greatest urgency to meet imperative military necessities. These immediate military demands were extinguished by the signing of the armistice. The problem now is to endow these plants with the maximum peace-time value, while maintaining and enhancing their war efficiency. This involves new questions in the technique of fertilization, and requires not only constructive but creative work. Following a careful study of the situation, it has been decided to establish forthwith a civilian organization, under the interdepartmental control of the Secretaries of War, Navy, Interior, and Agriculture, to be known as the United States Fixed-Nitrogen Administration, and charged with all the government's fixed-nitrogen interests. In due course the nitrate plants and other interests now administered by the Nitrate Division of the Ordnance Department of the Army will be turned over to this new fixed-nitrogen administration. Mr. Arthur Graham Glasgow has been requested to act as first administrator and to be responsible for creating the new organization.

UNIVERSITY AND EDUCATIONAL NEWS

THE Oberlin College administration has appointed a special faculty committee to stimulate original research among members of the science division. Hereafter when appointments are made to the teaching staffs of the various science divisions special consideration will be given to candidates who have already demonstrated some particular degree of fitness in conducting original research.

RECENT demands for men skilled in geology have led to the development of a special course in practical geology which is being instituted at the engineering schools of Columbia University. The course is three years in length and is intended to train men for advisory and professional work in connection with engineering and other operations involving a knowledge of ground structure as well as for special studies of mining prospects and developments and other more formal geological investigations. The course leads to the degree of engineer of mines in geology.

DR. GEORGE NORLIN, professor of Greek in the University of Colorado, has been elected president to succeed President Farrand. Dr. Norlin was elected to the presidency by the regents on the recommendation of a committee of the faculty.

DR. RALPH R. DYKSTRA, for eight years a member of the faculty of the Kansas State Agricultural College, has been appointed head of the department of veterinary medicine.

DR. A. B. DAWSON, Ph.D., (Harvard, 1918), professor of biology in the Mount Allison University, has been appointed assistant professor of microscopical anatomy in the Loyola University School of Medicine.

THE senate of London University has appointed Dr. Reginald R. Gates, M.A. (Mount Allison), D.Sc. (McGill), Ph.D. (Chicago), for three years as from January 1, 1919, to the newly-established university readership in botany tenable at King's College.

DISCUSSION AND CORRESPONDENCE

GERMAN TERMS IN ANATOMY

THE Anatomical Society of Great Britain and Ireland, at a meeting on March 1, 1918 at King's College, London, received and unanimously adopted a report by its Committee on Nomenclature. It resolved, without a dissentient vote, that the following paragraph of the report should be circulated among the several corporations and other bodies interested in the progress of medical education:

"The Committee, after consideration of the matter, unanimously reports that it sees no reason for departing from the use of the old nomenclature as the recognized medium of description for employment in anatomical textbooks and departments, or by medical men in general; on the other hand, it thinks that there are very good reasons to be urged against the adoption of any other nomenclature for this purpose."[1]

In accordance with this vote, inquiries are being made as to the attitude of various institutions toward the "old terminology" and the "new or Basle terminology," for it is recognized that "an educational problem of far reaching importance is at stake, on which the United States of America and the British Dominions have the right to be heard and their opinions considered." Meanwhile the arguments against the Basle terminology, which without any edict to enforce it, but through its inherent excellence, has been so generally adopted, are set forth by Professor Keith in the *British Medical Journal* of July, 1917. "Cursed be he that removeth his neighbour's landmarks" is his text, preceding the examination of what he terms "a wild ass movement" whereby a scheme of names is "being forced on English-speaking medical men." From all of which it would appear, to one who finds merit in the Basle nomenclature, that there is danger that great harm may be done through rulings of organizations, moved at present by justifiable anti-German feeling rather than by impartial considerations of science. Is this a favorable time to act in such a matter?

The Basle nomenclature, although prepared by a distinguished committee of German anatomists, is not German, but Latin, and there is no doubt that an international terminology for anatomy ought to be in Latin. It aims to be in correct Latin without abbreviations, and is an impressively scholarly achievement, placing anatomical terms on a far more dignified basis than those current, for example, in surgery. Whatever may be said of an occasional error in judgment—and there is extraordinary difference of opinion in the selection of these errors—the principles of the system are sound, and instead of being abandoned, should be extended to other branches. How difficult this task would prove is shown by the failure of international committees to make any progress with an embryological terminology or with one for comparative anatomy. These failures show the skill with which the Basle nomenclature was produced. The real question is, shall it be abandoned because of its German origin?

German in origin it certainly is, although the committee appointed certain collaborators from other countries and expressed its appreciation of the cooperation of Professors Thane, Romiti and Leboucq. No American member was appointed, partly because of distance and partly because Americans seemed committed to a "telegraphic system" whereby, for example, the vena cava posterior was designated the postcava. There is no defense for this system, and the committee acted wisely. It evidently appreciated Huxley's maxim that in the multitude of counsellors there is wisdom—in a few of them. So ten able anatomists worked by themselves for six years to simplify and improve nomenclature along the sound principles which they had adopted. We can not call this "the caprice of a handful of enthusiasts."[2]

The Basle nomenclature is surely not beyond criticism, but criticism should be concerned first of all with the principles involved. If those are sound and the system can be accepted, as it has been generally, then criticism as to the application of those principles in special cases may be constructive. What seems unprofitable is for every one to select here and there a term objectionable to himself and to set that forth in condemnation of the whole, as is usually done. Is it better to call the chief foramen of the mandible the *mandibular foramen,* or the

[1] This entire paragraph is quoted from the *British Med. Journ.,* March 30, 1918, p. 378.

[2] Editorial, *British Med. Journal,* July, 1917, pp. 121–122.

dental foramen? A dental foramen should be a foramen of, or pertaining to, a tooth, but would be applied in this case to a foramen of the mandible which transmits a nerve with branches to the teeth. Is *musculo-spiral* a well-constructed designation for a nerve containing both sensory and motor fibers, which passes somewhat spirally to the radial side of the arm of which it is the chief supply, or is it better to call it the *radial nerve?* The writer of the editorial previously cited prefers dental foramen and musculo-spiral nerve, together with several other rejected names which can not be discussed here. For example, he considers that a nerve which passes through a notch in the upper border of the scapula is properly designated in the Basle nomenclature the *suprascapular nerve,* but he believes that the notch of the scapula through which it passes is faultily named scapular instead of suprascapular. Here there is apparently an unsuspected precision in the Basle distinction which makes a part of the scapula *scapular,* and a structure above the scapula *suprascapular.* It should be noted that the editors announce that they would be the last to reject this system because of its German origin. On its merits and demerits they counsel British physicians not to accept it, even though "it has now been introduced in our most widely circulated manuals of anatomy."

Whatever terminology American anatomists may finally adopt, and they are, as every one knows, using the Basle nomenclature very extensively, it would be a cause of great regret if any issue were raised with their English colleagues, whose preeminence in descriptive anatomy is acknowledged, and whose Gray, Quain and Cunningham, the last with the Basle terminology, have been so profitably used for the instruction of our students. Recognizing fully the annoyance from petty changes in names and the great provocation, it may yet be hoped that the present opinion of the British anatomists is not final.

But in another important matter of terms, Americans ought certainly to change their practise and follow British usage. This is in the rejection of *anlage,* which indeed is only a single term, yet one used so frequently that it gives German color to a large part of our embryological literature. Some Americans never use the word, but others display it five times on a page, and it perhaps deserves special attention.

Wolff and the early embryologists used a variety of terms for anlage, such as rudimentum, tentamentum, fundamentum, primordium and initium, and Pander in his notable treatise in 1817 was content with Rudiment and Anfang, *e. g.,* die Anfänge der Wirbel. Von Baer used Anfang to some extent but preferred Anlage, changing Pander's phrase to "diese Anlagen der Wirbel," and perhaps through Von Baer anlage came to be a technical term. Americans studying in Germany thought it essential to borrow the word, since rudiment had come to imply a stunted organ, and fundament had an anatomical significance quite at variance with that desired. Either term may mean, however, exactly the beginning, the first indication, or primordium. So important was the use of anlage considered, that its definition has taken a prominent place in the introduction to certain American text-books, and the writer was among those taught that it was a *sine qua non* in embryology. Left in doubt whether the plural were better written anlagen or anlages, years ago I visited the venerable rhetorician, Professor Hill, for an opinion. "Is the English language then so poor that this idea can not be expressed without a foreign world?" he asked. "Oh yes, certainly, sir," I replied, with many reasons. "Then," said he, "if the language will be enriched thereby, it should be adopted, and probably the English plural would be preferable."

The fact is, nevertheless, that the idea can be conveyed in English with far greater accuracy through the abundance of expressions available. This may be shown by citing conspicuous instances from our recent journals. "The anlage and morphogenesis of the chorda dorsalis," seems to mean "the origin and development of the notochord," or perhaps "the

earliest stages and subsequent transformation." "The equivalence of hematopoietic anlages" is, as may be read in the article, a reference to hematopoietic centers. This paper states that the endothelial cell is "a hematopoietic anlage," that is, a *source* of blood corpuscles. That it does not give rise to blood-cells (is not such an anlage) is the converse of this proposition, as recently expressed in the *British Journal*. All organs in young embryos instead of being called hearts, stomachs, etc., may be called anlages of the same, giving abundant opportunity to employ the word, and necessitating references to "early anlages." In numberless cases it is used in place of a more exact term, *e. g.*, anlage of the liver, for hepatic diverticulum, or is introduced redundantly, as "the evagination which forms (the anlage of) the arm." Its entire absence from many of the most technical and best expressed embryological papers shows clearly that it is not needed. Is the English language enriched by it? It certainly could be employed in general literature:

> Tall oaks from little anlages grow,
> Large streams from little anlages flow.

The child is anlage of the man; and Lowell might exclaim, Puritanism—the anlage of democracy!

But in the interest of scientific accuracy and purer English it should be deleted. The term, if it remains, will mark the period of German dominance in American embryology.

FREDERIC T. LEWIS

A SIMPLE COVERING DEVICE FOR THE OCULAR OF THE MICROSCOPE

TO THE EDITOR OF SCIENCE: I have experienced so much trouble and expense from the injury to eye-glasses by contact with the ocular of the microscope, that I venture to describe my experience in solving the problem in the hope that it may be of interest to others similarly annoyed. Not being able to use the microscope without the correction to vision afforded by the eye lenses, I found for a number of years that the harder glass in the ocular invariably—in the course of six months or a year—covered the eye lenses with a maze of minute scratches and abrasions, rendering them unfit for further use and necessitating a very considerable expense in the purchase of new lenses, to say nothing of the lowered efficiency of the damaged glasses in the interim.

I first secured from one of the leading optical companies a pair of heavy rubber caps such as are used by them as a dust cap to protect oculars in storage. By cutting away a circular opening in the center of the cap (do not make it too large) I found the rim of rubber kept the two sets of lenses from coming in contact. These caps can readily be shifted from one ocular to another as occasion demands, or the cost is so slight that several sets can be afforded. They are, however, rather cumbersome and force the eye away from the lens perhaps an eighth of an inch, which is not always satisfactory.

A much simpler and, on the whole, more satisfactory device may be made by taking a circular piece of ordinary sheet rubber (such as dentists use extensively) about an inch and a half in diameter; cutting a small hole at the center, and stretching and tying it securely with fine thread below the knurled cap of the ocular. This allows the eye to approach very closely to the ocular; and, besides thoroughly safeguarding the eye-glasses from injury, it does away with the very annoying noise caused by the constant shifting of the two glass lenses on each other.

I now have every ocular covered in this way and shall never again be without the comfort and economy so afforded.

CLELL LEE METCALF
DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY,
OHIO STATE UNIVERSITY

CURIOUS DIFFERENTIATION IN FROST EFFECTS

TO THE EDITOR OF SCIENCE: A curious differentiation in frost effects on foliage came under the writer's observation yesterday. On Friday morning, November 1, a self-recording standard thermometer registered 32 degrees F. as the minimum during the preceding night, followed by a record of 31 degrees the follow-

ing morning. Such temperature usually produce immediate and decided effects on vegetation, assuming the character of "killing frosts."

On the following Sunday morning the writer made a run on the road leading out of Clarksdale, which for three miles traverses ground near to what was the bank of the Mississippi River before a "cut-off" several centuries ago converted this part of the river channel into a lake. The road then turns from the old river bank and traverses fields in the interior.

There is a luxuriant growth of cotton along the road for many miles, and that which is on the ground in the vicinity of the former bank of the river is green and vigorous in appearance, showing no effects of frost; while all the foliage on the cotton in the fields remote from the river bank was completely killed.

The thermometer that recorded the above temperature is located near the old river bank, and at the same elevation as the growth of cotton stalks referred to.

The writer is unable to imagine an agency that could produce the results above recited, except a difference in the character of the soil in which the cotton grows.

The soil near the old river bank is composed of river silt mainly, while that of the interior fields is a heavy, dark clay, locally called "buck shot."

The assumption is that the silty soil possesses the property of storing the sun heat during the day, and that this stored heat given out during the night protected the cotton from the frost temperature; and that the clay soil does not possess this property in the same degree.

The frost temperatures above noted came rather suddenly, without preceding low temperatures to deprive the soil of previously stored heat.

It should have been stated that the "old river channel" above referred to is not now a body of water, but by gradual filling has become arable land. Also that this is a level country.

T. G. DABNEY

QUOTATIONS

HOW TO AVOID INFLUENZA

ALTHOUGH man has lived in houses of one kind or another for several thousand years, and in western Europe since the introduction, somewhere in the fifteenth century, of glass for domestic windows, in houses which can be almost hermetically sealed, yet a human strain capable of withstanding the evil influences of unventilated rooms has not so far been evolved. Our ancestors of a few centuries ago immured themselves in tightly-closed houses, slept in bedrooms with windows closed, sometimes even in cupboards or box beds with shut doors. The result was reflected in their mortality, in the prevalence of the plague and other plagues, and in their short average span of life. Though we are wiser than they, and pay lip service to the virtues of fresh air, and talk much and learnedly on ventilation, the severity of the present pandemic of influenza is enough to show that we need to grow wiser. Dr. Leonard Hill, who has done perhaps more than any one else to give a scientific explanation of the air conditions of health, makes another contribution to our pages this week in which he relates some interesting experiments on himself and other volunteers. They lead him to urge as the best means of combating the infection of influenza, the deep breathing of cool air brought about by exercise, and by sleeping in the open air—this last perhaps a counsel of perfection. The advice applies not only to influenza itself, but to the colds and catarrhs which, in the aggregate, are responsible for so much discomfort and loss of efficiency. A striking illustration has been related to us by Colonel C. T. C. de Crespigny, D.S.O., A.A.M.C. During August, 1918, a transport left Australia bound for Great Britain. The 1,200 troops which she carried were accommodated in four troop decks of about equal capacity. Three decks were well ventilated with windsails, but the fourth deck was in this respect very unsatisfactory. Early in the voyage a form of infective pharyngitis and epidemic catarrh broke out among the troops. The incidence of the infection was ten times greater among the men occupying the

badly ventilated decks than it was among the others. In all other respects the men were exposed to precisely similar conditions; they wore the same clothes, ate the same food, and all of them slept in hammocks slung very close together. Thus the experience has the value of a carefully planned experiment in showing the effect of freely moving air as a preventive of infections of this nature. Another striking instance, recorded by Colonel Adami, F.R.S., in the first volume of his book on the "War Story of the Canadian Army Medical Corps," was noted in the review published in the first number for this year. The winter of 1914–15 was very wet, and the troops under canvas on Salisbury Plain suffered extreme discomfort, but nevertheless continued in excellent health. When, after some six weeks, the discomfort of tent life and the increasing cold of winter induced the authorities to replace the tents by huts, then influenza and throat troubles began to spread at once and rapidly, and, what was worse still, a series of cases of cerebro-spinal fever occurred.—*The British Medical Journal.*

SCIENTIFIC BOOKS

Life Zone Investigations in Wyoming. Merritt Cary. North American Fauna, No. 42. October 3, 1917, pp. 1–95; pls. I.–XV.; text figs. 1–17.

The Biological Survey has for many years been gathering data on the ecological relations of animals and plants in North America with particular reference to the transcontinental life zones. Several generalized maps of the entire continent have been published, and a series of detailed studies by states and provinces is well under way. The results of some of the latter have already been published, and another is now presented in the present report on Wyoming. This is based on a number of years' field work in the state by the author and other members of the Biological Survey.

In a brief introduction attention is called to the life zones as "a fairly accurate index to average climatic conditions, and, therefore, . . . useful as marking the limits of agricultural possibilities, so far as these are dependent upon climate." They are thus valuable as an index to the possibilities of agriculture in undeveloped regions.

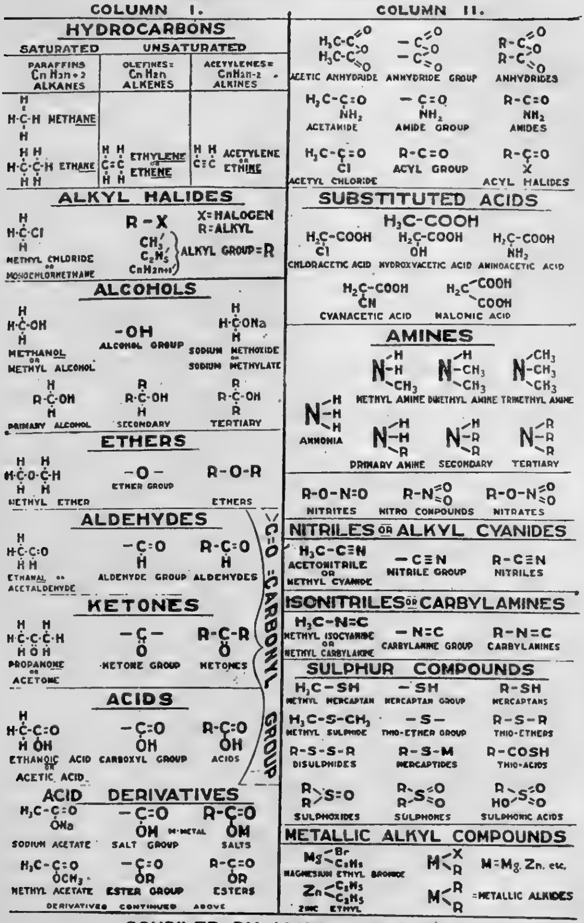
With the caption "Physiography and Climate," there is also a description of the varied physiography of Wyoming, which is characterized particularly by mountains, plains and valley basins. This variety of surface produces likewise a varied climate, though mostly cool by reason of the high base level, and arid excepting on the higher mountains.

Under the heading "Life Zones of Wyoming," the transcontinental ecologic belts occurring in the state are treated at length, and a careful account is given of their divisions, if any, their area, altitudes, the most important localities covered by each, their physical and faunal characteristics, and their agricultural possibilities. For each zone there are added long lists of trees, shrubs, herbaceous plants, of mammals, and of breeding birds; mention is made also of reptiles, but of no other vertebrates and of no invertebrates. Doubtless, however, the mollusks and insects would, at least in the main, substantiate the results obtained from the plants and the higher vertebrates. The characteristics of these five zones are so carefully worked out that a summary of the author's conclusions may be worth presenting in this connection.

The Upper Sonoran Zone, which occupies most of the valleys and lower plains, from altitudes of 3,100 to 6,500 feet, is the home of the broad-leaved cottonwood, juniper, salt bush and yucca; of such mammals as *Eutamias minimus pictus, Citellus tridecemlineatus parvus, Lepus californicus melanotis;* and of such breeding birds as *Zenaidura macroura marginella, Tyrannus vociferans, Passerina amœna,* and *Icteria virens longicauda.*

The Transition Zone, which embraces the high plains, the basal slopes of the mountains, and all the foothills except the highest, and ranges from altitudes of 4,000 to 8,500 feet, is characterized by yellow pine, narrow-leaved cottonwood, and sage brush; mammals like *Odocoileus virginianus macrourus, Sciurus hudsonicus dakotensis, Neotoma cinerea cinerea,* and *Lepus townsendi campanius;* and such breeding birds as *Centrocercus urophasianus, Cryptoglaux acadica acadica, Empidonax*

ORGANIC TYPE FORMULAE
ALIPHATIC SERIES



COMPILED BY ALEXANDER LOWY.

wrightii, Cyanocephalus cyanocephalus, and *Hylocichla fuscescens salicicola.*

The Canadian Zone, which covers the middle mountain slopes and the highest foothill ranges, occurring at altitudes of from 7,500 to 10,500 feet, is the boreal forest belt of spruce, fir, lodgepole pine, and aspen; and is furthermore delimited by such mammals as *Alces americanus shirasi, Glaucomys sabrinus bangsi, Phenacomys orophilus, Evotomys gapperi galei,* and *Lepus americanus americanus;* with such birds as *Charitonetta albeola, Nuttallornis borealis, Melospiza lincolnii lincolnii, and Sitta canadensis.*

The Hudsonian Zone, which is a narrow belt covering the timberline region, and ranging from altitudes of 9,000 to 11,200 feet, is marked chiefly by the white-barked pine, dwarfed spruce and fir; together with such mammals as *Ovis canadensis canadensis, Eutamias oreocetes,* and *Ochotona uinta;* and such birds as *Nucifraga columbiana* and *Pinicola enucleator montana.*

The Arctic-Alpine Zone, which occupies the mountain crests and the portion of the peaks above timberline, in places from 9,500 to 13,785 feet altitude (the summit of the highest mountain in the State), is a treeless area, the vegetation of which is limited to low bushes like *Salix nivalis,* and other humble plants like *Dryas octopetala* and *Poa arctica,* and is the home of such breeding birds as *Lagopus leucurus altipetens, Leucosticte australis, Leucosticte atrata* and *Anthus spinoletta rubescens.*

The term "Upper Sonoran" as used here is really not a zone in the strict sense, and would be better called "Upper Austral," of which zone it is the western arid division. Although no mention is made of the fact, the so-called "Arctic-Alpine Zone" is really a part of the Arctic Region, which, in North America, covers the tundra area of the northern part of the continent and the mountain tops above timberline in the more southern parts of Canada and in the United States; and the four other zones of Wyoming belong to the Nearctic Region.

Following the main part of this bulletin is a well-annotated list of the conspicuous trees and shrubs of Wyoming that are of importance in the delimitation of life zones. The numerous half-tones illustrate the different types of physiography and the ecological relations of the vegetation. Of particular interest are the pictures of *Picea engelmanni* and *Pipus albicaulis* at timberline, which show the dwarfing and distorting effects of the severe climatic conditions under which they here live.

The author's careful and detailed treatment of this extremely interesting and intricate subject leaves little to be desired; and it is a matter of great regret that he could not have lived to carry his investigations into other parts of the United States.

Harry C. Oberholser

SPECIAL ARTICLES

A CHART OF ORGANIC CHEMISTRY, ALIPHATIC SERIES

In connection with the elementary organic chemistry course given at the university I deemed it advisable to have charts made to be placed in the lecture and laboratory rooms, where students may consult them at all times. In order to emphasize certain endings, type groups, etc., red lettering was used.

The chart, which is 92″ x 55″, is reproduced on the preceding page.

An analogous chart of the aromatic series is in course of preparation.

Alexander Lowy

School of Chemistry,
University of Pittsburgh

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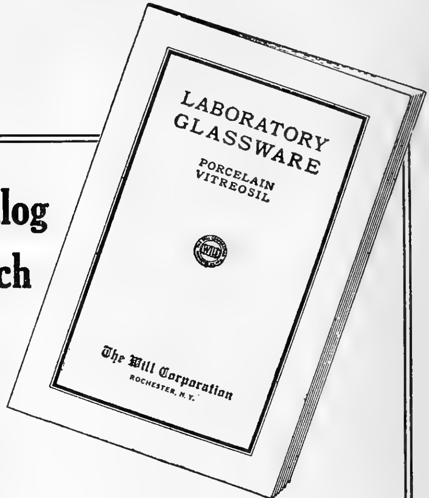

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SCIENCE

FRIDAY, APRIL 4, 1919

CONTENTS

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MEDICINE AND GROWTH[1]

DOUBTLESS friends have congratulated you on the fact that you were "through." In one sense—a strictly academic sense—that is true, else you would not be here, subject to this ordeal. But perhaps there is another way of looking at the situation. The Greek philosopher, Pyrrho, contended that against every statement the contradictory may be advanced with equal reason, and following this estimable skeptic, I feel justified in the assertion that, as a matter of fact, you are not "through," but rather are just commencing doctor of medicine, if one may give the word commence its older meaning.

You have qualified for a degree—a degree which entitles you to membership in a learned profession—that, like the church and the law, has the distinguishing responsibility of dealing with matters of life and death.

A profession makes heavier claims on its representatives than does a trade or an art, for in the nature of the case it demands continued progress, and it is part of the unwritten law that those who enjoy the prestige which such a position brings, should leave their profession better than they found it.

To do this implies progress—progress by growth, and it is the idea of growth that I wish to use as a guiding thread for the conduct of this talk. It is my purpose then to say a word concerning growth as it affects that very important person, the patient; then to speak of growth as it touches the body of medical knowledge; and finally to consider growth as it affects the physician in his riper years.

To follow an old time form let me announce

[1] Address to the graduates of the Medical Department of New York University. Delivered at the special commencement exercises, held at University Heights, New York, on Saturday, March 1, 1919.

my first thesis, namely: that a patient is always changing, growing.

Johannis Bernoulli, a member of the most remarkable family of mathematicians of which we have a record, published in 1699 a thesis in which he maintained the continual change of substance of the body.

His argument drew the theological lightning of his day, and he forebore to push his studies further, but his ideas were passed along, and I know that in my youth no self-respecting popular physiology failed to repeat the statement that the human body underwent a complete change of substance once in seven years.

We look at matters somewhat differently today but it is not without interest to record that this idea of change started under such eminent patronage. The modifications due to growth are another matter, yet the idea of growth, despite the universality of the phenomenon, has been only gradually assimilated and put to use.

In earlier times growth was but little considered. We need not go back very far in medical history to find that the typical patient was the person already grown. The patient was thus standardized.

The young were dealt with by midwives and grandmothers, and the aged took care of one another.

Speaking in the broadest way the physician's business was to care for that mythical person, the average man, to whom the recorded facts of anatomy and physiology all applied; for the phases of growth were not then regarded in these disciplines, and medicine shared with art and education a curious blindness to developmental changes. Great advances have occurred. We now have those clinicians who give special care to children, to adolescents or to the aged.

The relations of age to the incidence of disease, as in the children's diseases, in typhoid or in cancer, have directed attention to progressive alterations within the individual, a series of changes which are quite aside from the marks of maturity or the signs of old age.

Thus men of a given race pass through a series of well recognized phases and, as in a set of dissolving views, infancy merges into childhood and childhood is transformed to youth, and so within the span of life we have revealed the seven ages of man, so quaintly sketched by Shakespeare.

Familiar as these phases are it has taken no small labor to bring them into the field of practise and to have them recognized as of clinical importance. There is the same difficulty here that appears in carrying over to our laboratory work the ideas of variability and of graded relationship which were developed by Darwin and those who followed in his steps.

We know that individuals differ in their form and anatomy, but we wish they didn't; it would be so much easier if they were all just alike.

We know, too, that what is true of structure is also true with regard to the functions of the body. Here the facts are harder to appraise, and there is a still stronger tendency to dodge them. But this avails us nothing. The facts will find us out—and moreover they are unpleasantly immortal.

The idea which I wish to drive home is this: During the span of life the body shows changes more or less like those shown by a battered ship or neglected automobile, but behind these lies a set of changes which no dead structure or machine exhibits, a progressive chemical alteration of the body linked with age, probably affecting all its parts, and constituting the series of modifications characteristic for the individuals of any species, as these pass from birth to senile death.

The mechanism which prepares our food; that which distributes the food-bearing blood; the nervous system which controls our behavior; the muscles which do the work, and the internal secretions from the ductless glands and other sources which serve to tune or tone our organs, all these undergo with age changes not only in themselves but in their relations to one another.

On the balance of these component parts depends that somewhat subtle character called

temperament, which though elusive, has a real existence and an importance hard to overestimate. Temperament is the expression of these relations and one of the nice problems the clinician has to face.

Under certain circumstances it makes a difference whether one has light hair or dark, not because these characters are themselves important, but because they are indicative of subtle dissimilarities in the chemistry of different individuals, dissimilarities which are of far-reaching importance for the individual as a whole.

Recently it has become possible to do our laboratory work with animals the ages of which are known. Working thus we find at every turn differences, distinct and definite, dependent on the age, differences which should be studied, for without shadow of doubt they will be found in man when search for them is made.

I make no question that much of what I have just said to you has a familiar sound, but the time is coming, I feel sure, when the significance of age will be appreciated in many fields where now it is but little noted, as for example in the blood, and I have spoken thus to specially direct your thought to these matters.

Thus far the individual who is growing normally and who represents the usual case has been considered. In passing, however, it may be worth while to turn for a moment to the individual subjected to starvation. The terrible years through which the world has just passed have brought starvation vividly before us. We know that in starvation growth is modified and may apparently be stopped.

As in so many other instances our knowledge of the changes thus induced is still fragmentary and incomplete. In the first place we must distinguish between the starvation which follows when the quantity of an adequate diet is made unduly small, and the case in which the diet is unbalanced and defective in itself, and therefore only slightly modified by quantitative variation. It is the former case to which I would draw attention here.

If we may trust the tests with animals, two systems tend strongly to resist mere quantitative underfeeding—the skeleton and the nervous system. Growth in them is greatly retarded to be sure by underfeeding, but they may still grow, while the body as a whole is held at a constant weight or is even losing.

The practical question before us however is not so much the immediate effects of starvation, as the response which such an animal will make when it is brought back to a full and normal food supply.

The nervous system is best known to me and I think we may say with regard to this system that a return to the normal diet is followed by nearly, if not quite, complete recovery. This is a cheering and hopeful result and yet, as always, a word of caution is in place. Starvation, as followed in the laboratory, can be studied free from the complicating conditions of the exhausting systemic diseases, so often associated with starvation in human communities, and what is true for the simple conditions of the laboratory may not be true for those which are more complex.

Nevertheless in these days, when underfeeding is much in evidence, it is of interest to note that one form of it at least does not cause permanent damage to the great master system of the body.

The life histories of many students and productive scholars support this conclusion, for biographies show only too frequently, periods of starvation in the lives of those who, then and later, were distinguished for intellectual activity.

Thus far I have been speaking of growth as it modifies the patient, when that long-suffering person is looked at as a biological problem.

Now let me pass to the second topic and ask you to consider the growth of medical knowledge.

The mass of knowledge in any subject may be likened to a sphere which is rolled on from generation to generation, always growing by additions on the surface.

All of us, as scholars or investigators, are entrusted with its preservation and its in-

crease, but like the sacred beetles that also have their sphere, we often roll our load with clumsy slowness and humorous mishaps. Nevertheless this sphere contains our intellectual pabulum and is worth close scrutiny.

In the first place it is to be observed that like the moon the apparent size of this sphere is highly variable. When we first view it in the early student years it appears to have moderate dimensions. Later it seems enormous, but as the years go on it shrinks once more, and I venture to think that in this last phase our impressions correspond more nearly to reality.

An analysis of this experience may be worth while. The mass before us is typified by all that has been written plus the traditional wisdom which is handed down from teacher to pupil. When the written records are examined it becomes evident that the greater portion of them are formed by an enormous accumulation of evidence and arguments for a relatively small number of important conclusions, and also for a multitude of hypotheses which have perished by the way.

Did you ever go into a well-stocked library in which the books dealing with a given subject were arranged in their historical sequence, and then ask yourself what could be said of these—what was their larger meaning? It is worth doing. One can, of course, dismiss the greater number as out of date, a few only have the power to remain alive. Yet all these books, or nearly all, passed through a period when they were consulted and esteemed.

It is plain that most of our medical literature, including that which represents the fundamental sciences, is concerned with the presentation of evidence and arguments for some point of view. In the end the conclusions can be stated in a few words. When these conclusions are established and made certain, much of the literature developed by the way becomes of historic interest only, to be treasured and preserved of course, but removed from the field of central vision.

Thus when malaria was shown to be due to pathogenic organisms—insectborne—the antecedent literature concerned with other theories of its etiology ceased to be intructive.

One result of recognizing such a change is to make the sphere of knowledge seem less ponderous, yet it is never a small matter, and there is always with us the question how we can best handle this load of learning. In many cases it is necessary to carry only a skeleton outline of the existing knowledge, yet one must be ever ready to follow a subject into all of its details, when the occasion demands.

All this takes time and time presses ceaselessly. Always we have with us the stubborn fact that three score and ten years make a full life, and that although the day may be shortened by legislative action, no hours can be added.

Joseph Leidy, the distinguished naturalist, once said that he could carry some 20,000 names in mind, but if new ones were to be acquired, some of the old ones must be forgotten.

This is a somewhat cryptic saying and invites psychological analysis, but it also serves to direct attention to the limitations which beset even those exceptionally endowed. Apparently we only carry those facts which from time to time can be recalled. Neglect them and they get lost: like foraging pigs they must be called in now and then or they will forget the way home.

This sphere of learning which we have in view is composed of facts that date from many centuries. Some are surely very ancient, and strictly new ideas are hard to come by. Our classical friends are fond of pointing out that many ideas which we parade today were known to the Greek philosophers 2,000 years ago. Of course if persons make a business of thinking, as did this group among the ancients, they are bound to reach a number of more or less logical conclusions, though some of them may be quite contradictory. It was not until such rival conclusions could be put to the experimental test that it was possible to sift the true from the false, and therefore our biological science deals with no small number of ancient ideas

and the contribution of the modern workers is the selection of those which can survive the trial. As the expression goes: we test the hypothesis. Ideas which can survive the blows and buffets of time have a certain prestige and dignity which is to be reckoned to their credit, while the number born to perish, those that appear but once, are as the eggs of a fish. Moreover, it is most important for us in weighing the worth of ideas to know something of their history—I might almost say their ancestry—and not to confuse the unbaked results of the hour with those that have an ancient lineage. If we realize then the persistent character of all first-class problems, it ceases to be a wonder that when the results of an investigation are followed back into the literature, some of them may be found foreshadowed there or even definitely formulated, sometimes on good grounds, sometimes on bad.

Of course there are critical points in the advancement of knowledge which, when passed, make possible conclusions that are plainly novel and could not have been reached before. The aspect of medicine changed after Harvey discovered the circulation of the blood. The heat of the body appeared in a new light after Lavoisier developed the theory of oxidation. Galvani's observations on the nerves and muscles of frogs gave a new idea of the nervous impulse, and Johannes Müller's doctrine of the specific energies of nerves revolutionized our notions of the sense organs. Infectious disease suddenly became intelligible in the light of the work of Pasteur, and the doctrine of internal secretions and the chemical messengers, taking its departure from the observations of Brown-Sequard, shed a world of light on the control of body functions and relieved the nervous system from responsibilities which were proving too heavy for it.

If then we come back to our sphere of knowledge and endeavor to see in what manner it is compounded, we find in it ideas which repeat themselves at every revolution. We find great masses of information which, because they have served their purpose in establishing points of view, now have mainly an historical interest, and overlying all, most conspicuous and best known is the newer knowledge, the kind you have just labored to acquire, composed of these elements in part but in larger part consisting of detailed evidence, valuable for the newer points of view.

It requires some skill to manipulate this mass of information without being smothered by the dust of it, but handbooks, summaries, digests, reviews and journals deal with it in such a way that one can get their bearings with a comparatively small expenditure of time.

There still remains the question how this information by which we live should be regarded. There have been communities and times when medical learning was handled almost as a trade secret, indeed the Hippocratic oath suggests that this idea was an ancient one. It was as though the possessor had acquired a fixed and rigid formula for making a peculiarly good article useful to the public, but the production of which should be protected. This attitude has been abandoned happily, save in the most backward communities and among the least intelligent practitioners. The modern and the progressive view is quite different. It is in harmony with the response of John Hunter the great comparative anatomist, when some one quoted to him a statement which he had made a year before. "Sir," he replied, "I am not to be held by my statements of a year ago." He had progressed in the interval and he had accordingly changed his opinion. The knowledge which has been presented to you, and to which you have added by your own industry, is to be sure the best available at the moment, but that is the most that can be said of medicine and the most that can be said of any science. If we believed otherwise, if for a moment we thought of it as fixed and final, those of us at least who work in laboratories would promptly go into the chrysalis stage and somnolently wait for immortality. That however is not done. To-day the best use possible is made of such information as we have been able to gather, but with the confident expectation that to-morrow will bring new knowledge. Look at the extension of our

notion of the ether familiar to most of you in the Röntgen rays, or the sudden widening of the chemical horizon by the discovery of radium and the analysis of the atom into its constituent electrons. These new ideas make the older men to think, a painful process, and, because painful, avoided if possible.

Now, even in medicine, there are difficulties of this sort which create a somewhat trying situation.

I have been appalled by the apathy of some of my medical friends towards the experimental work which goes on in the laboratory. We need encouragement and protection in the laboratories, especially for such work as involves the study of the living animal. Vivisection this is called by those who oppose the study of the living animal—but as there is no essential difference between this work and either surgery or medicine—by the same token both surgery and medicine are vivisection. So we may compromise, and speak of this operative work as animal surgery or medicine. Many studies require to be made on the living animal but here in this community, and those communities in which my lot has been cast, such study is often strenuously opposed by some who will not see its value. I had supposed that my clinical friends, representing as they do the most influential group of professional men at the present day, would rise in a body and say *this work is necessary for our progress and the advancement of our profession*—but they did not. I tried to find out why.

Various reasons appeared—some of which may occur to you without my mention of them—but the one which arrested my attention was a sort of mental inertia, a dislike of change and of the labor of rearranging old ideas to meet the new conditions consequent on new advances. It was argued too that the laboratories were often misleading and that discoveries were put forward for general use long before they had been tested and retested with the caution that the case demanded. Reference was made to the famous instance of tuberculin, for which Koch appears to have been really less responsible than those who at the time dictated his utterances. The criticism is, however, in a measure just. I am painfully aware that in the laboratory a remoteness from real life sometimes weakens the sense of responsibility for results which are put forth, but these last decades, and especially the very last, have shown a vast improvement in this relation and the cooperation between the clinic and the laboratory has become most happily intimate.

I have spoken of the laboratory because it is an important source of knowledge for the clinician, though most naturally farthest removed from his daily experience. I ask you to remember that one may help medicine and yet do it as a chemist, a botanist or a zoologist —quite detached from the clinical applications of what is found. To grow pathologic organisms is a biological problem; to follow insect borne diseases takes one into entomology. The applications to medicine are incidental, but often of the greatest import. Remote then may be the sources of facts important for the practitioner, but, although they are remote, these sources should be neither forgotten nor neglected.

Though your knowledge is the best at the moment, yet to-morrow may see a change for the better by the introduction of some advance based on what is now an incidental laboratory test or clinical observation—yet to be applied. For the protection of this laboratory work not only your interest but your moral and professional support is needed.

I have dwelt on the fact that the patient is a different individual at different ages, and that your knowledge and ideas must change and grow with the continued pondering of experience. In that connection there is just one word to add. It touches growth in the physician himself—a very vital matter.

The intelligence tests about which much controversy has been waged during the past ten years have come to stay. They sometimes are disquieting. It is said that an intelligence of nine years suffices to rear and bring up a child. I do not know just what mental age admits one to the laboratory. Though further applications to the problems before you are

not needed here, yet I do want to point out that these tests show in a somewhat precise way a fact that can hardly have failed to strike us all, namely, that our associates stop growing mentally at quite different ages, some continuing to grow long after others have reached their limit.

When Cato learned Greek at eighty years it indicated more than that the farm was doing well and he had time to spare. It indicated a capacity for new interests and a mental retentiveness which are among the virtues of the youthful mind.

These are endowments which we would all desire but which are unevenly possessed. However, in any discussion which involves the problem of nature versus nurture, it can always be pointed out that whatsoever nature has or has not done, there still remains the possibility of modifying nurture—or the environment—and these possible modifications are worth attention.

Observation shows us that the differences between men are small, but that, small as they may be, they amount to a great deal. Slight improvement is worth a struggle and repays the effort. I am commending to you therefore the effort to keep growing mentally.

A remarkable example is that of Helmholtz.

Helmholtz began as a physician—a very mediocre practitioner they say—but under the inspiration of Johannes Müller he became interested in physiology. This branch he followed by the study of the eye and ear, leading to his great works on physiological optics and sensations of tone—by the way devising that important instrument the ophthalmoscope. But the physiology of the sense organs called for physics. So well did he follow this lead that he became one of the first physicists, and linked his name with the doctrine of the conservation of energy. Still going forward he developed his mathematics and became eminent in that field also. Here is a steady growth through a long life. A great intellectual engine at his command was applied to field after field in succession, and always with a resulting advance in knowledge.

Such men set the pace and these pace-makers are the most helpful members of our race, for while those who have stopped growing have but a single response, "It can't be done," the pace-makers do it.

Naturally you ask what is the formula, how is it accomplished? Let me reply by a question: What do you think about when you are not working? For most of us that period represents the larger part of life, and it does make a difference what we do with this great fraction, so I will leave the implications of my question without elaboration, but ask you to meditate upon it.

There is however a further matter which lies closer at hand. Let us consider the "Bohemian." I mean the individual who bears this name by virtue of his behavior. He is worthy of attention. He protests against the restriction of conventions, sometimes in a not too seemly manner, but at his best with the hope of getting free from conditions which hamper thought or work. We all suffer from these restrictions in a mild way. By all accounts the savage seems to be most completely surrounded by taboos and conventional restraint. His is not a happy lot. Civilized man suffers less, and yet conventions stand in our way.

The necessity of getting back for dinner cuts into an experiment. The idea that one retires at a certain hour limits a series of observations. Very trifling these conditions, you will say, yet breaking life up into small lengths in a way which often interferes. War teaches us something here that may be useful.

In this connection I love the story of von Baer. Von Baer, the embryologist, tells how he went into his laboratory when the leaves were falling in the autumn and came out again when the spring flowers were in bloom. That was a day's work that counted, and we can do well to ponder on it. Von Baer was the sort of Bohemian I have in mind.

Here I rest my case.

The past four years have meant great things for medicine. For the first time in history the fighting man has had the best that medicine could give. Certain forms of practise have advanced by leaps and bounds. and you

come into action when medicine still feels the impulse of these strenuous years.

The laboratory and the clinic have collaborated as never before and the future is full of promise.

Under these conditions it has been my privilege to give you encouragement and a bit of counsel, and I feel indebted for the opportunity. Henry H. Donaldson

WILLIAM ERSKINE KELLICOTT

A constantly lengthening list of scientific men who have surrendered their lives in varied war services, or in that harder, more exacting fight with microbial enemies, is one of those news columns which our eyes have come to scan with a strange mingling of suspense and unwilling, silent complacency. The world, and each of us in it, has become immeasurably poorer because of this great drain upon potential mental energy; and the lost men, as a rule, have had capacities for friendship directly commensurate with their intellectual powers.

Not a few American zoologists were particularly moved by a recent item of this sort; and to the list we are now compelled to append the name of William Erskine Kellicott, who was taken away by pneumonia, after illness of a week, at his home, in Hastings-on-Hudson, N. Y., January 29, 1919. Though but forty years of age, he, among scientists, teachers, critics and friends, had become to many their great, to some their greatest, satisfaction.

His career may be briefly summarized as follows: he was born in Buffalo, N. Y., April 5, 1878, the son of David Simmons Kellicott and Valeria Erskine Stowell. His father, at that time, was head of the science department in the Buffalo State Normal School. His earlier educational training was received entirely at home, so that he began his high school studies, at the age of twelve years, directly from his mother's tuition. This occurred at Columbus, Ohio, the second year of his father's appointment to the chair of biology in Ohio State University. After completion of his high school course, he entered the university, from which he received the degree of Ph.B. in 1898, with election to Sigma Xi. Later, on organization of a chapter of Phi Beta Kappa at Ohio State, he was chosen to that society also.

His undergraduate work was shaped and pursued with entire reference to a future career in surgery; but his father's death in his senior year changed this cherished plan, and he spent his first post-graduate year in teaching biological subjects in the high school at Marysville, Ohio. The following summer he was a student in the invertebrate zoology course at the Marine Biological Laboratory, Woods Hole, Mass., and it was at this time that Kellicott decided to devote his energies to zoological science. In the autumn of 1899 be began graduate study at Columbia University, and received the doctorate in 1904, his major thesis being entitled "The Development of the Vascular and Respiratory Systems of *Ceratodus*."

The following positions were occupied by him for the term of years indicated:

In Barnard College, assistant in zoology, '01–'02; tutor, '02–'05; instructor, '05–'06.

In Goucher College, professor of biology, '06–'18.

In College of the City of New York, professor of biology, '18–.

In the Marine Biological Laboratory, instructor in embryology, '11, '12, '14; in charge of the embryology course, '15–.

For the year 1912–13 he was fellow of the Kahn Foundation for the Foreign Travel of American Teachers, and as such was enabled to visit many European countries and numerous centers of interest in Siberia, China, Japan and India. His report to the foundation offers interesting proof of his discriminating analysis of human nature.

In July, 1918, he resigned as assistant statistician of the U. S. Food Administration, having served one year; during this time he devised and put into operation a thorough and efficient system of gathering data from dealers in food all over the country, definitely stamping the square dealer and the profiteer.

He was a fellow of the American Association for the Advancement of Science, a member of the American Society of Zoologists, of the American Naturalists, and of the New York Academy of Sciences.

On September 11, 1901, he was married to Mary Chappel Hicks, of Columbus, Ohio. Their daughter, Janet, fourteen, is now busy with her high school studies.

Not taking into consideration the devotion and thoughtfulness which characterized his home life, the main enthusiasm of this man was in the field of science; and this for the simple reason that he could tolerate nothing except truth. Keenly appreciative of language and literature, still he felt them to be of special value as being a means of giving expression to some sort or phase of truth. As an investigator he very sharply discriminated between the significant and the pointless, a clear, long perspective stretching out before the former, while the latter was given little patience. Kellicott had not chosen a particular problem as his special zoological interest; his research contributed to our knowledge of cytology, normal embryology, correlation, growth measurements, animal breeding and factors influencing development. A second paper dealing with the last-named question was in process of writing at the time of his death. He often reprimanded himself for thus not concentrating his investigative effort, and he doubtless would have selected a special field ere long; but ever insistent with him was the conviction that he must school himself in the current zoological movements of the day, that he might be the better trained and speak and think out of his own experiences. Exacting, though always kindly, in his teaching, he prescribed an even greater degree of discipline for himself. Assumption was seldom a mental experience with him. The following quotation is one of his own selection—"Surely, if there is any knowledge which is of most worth, it is knowledge of the ways by which anything is entitled to be called *knowledge,* instead of being mere *opinion,* or *guesswork,* or *dogma*" (Dewey).

As a teacher Kellicott instinctively knew the art of making subject matter appeal because of its own intrinsic significance; he did not obscure it by obtruding mannerisms or his own personality. Seldom is a man given a greater degree of loyalty by his students, or for better reasons, than was he. As a participant in administrative matters, he was broad-minded, simultaneously unafraid and cooperating, independent of precedent and practise where these seemed wasteful or obstructive. His influence seemed uniformly disproportionate to the length of his service and his academic title.

Kellicott's nature was too large to permit expression in one field alone. It was magnetically drawn toward the beautiful in music, in art, in the sculpture and adornment of nature's earth, and in human nature. His capacity for friendship was exceptional; companions of his own age felt themselves rich in the resources which were his; his seniors, startled by his passing, have become aware of how large a place he occupied in their confidence. One of them has written: "I didn't really know how much I loved the lad. I had formed the habit, unconscious till now, of thinking to myself, 'How would that strike Kellicott?'"

Side by side with his straight directness in thought and action, there dwelt a subtle, copious humor, an unstinted unselfishness and generosity, a buoyant gladness, which, as he "dwelt by the side of the road" of human lives, made him, in uncommon degree, "a friend to man."

It is better, and more just, that we do not circumscribe and limit the loss which has come upon science, the teaching profession, and upon his widening circle of friends by attempting to define in words the significance of the death of William Erskine Kellicott. "He is so vivid a man that he defends himself in your own mind against misinterpretation."

Robert A. Budington

SCIENTIFIC EVENTS

THE DIRECTORSHIP OF THE BRITISH NATURAL HISTORY MUSEUM

Sir Lazarus Fletcher retired on March 3 from the directorship of the Natural History Museum after forty-one years in its service. Previous to his appointment as director in 1909, he had served two years as assistant and twenty-nine years as keeper in the Mineral Department. In connecton with the appointment of his successor *Nature* prints the follow-

ing letter signed by twenty-three distinguished naturalists:

The director of the British Museum (Natural History) is about to retire, and we learn with deep apprehension that the principal trustees, with whom the appointment rests, have received, or are about to receive, from the general body of trustees a recommendation to pass over the claims of scientific men and to appoint a lay official, who is at present assistant secretary. The former directors, Sir Richard Owen, Sir William Flower, and Sir Ray Lankester, like the present director, Sir Lazarus Fletcher, were all distinguished scientific men. The Natural History Museum is a scientific institution. There is a large staff of scientific keepers and assistants. The director has to represent natural history to the public, to other scientific institutions at home, in the dominions and colonies, and in foreign countries, and to the many government departments with which the museum has relations. He must represent it with knowledge and authority. There are few posts with such possibilities of advancing the natural history sciences, of making them useful to the nation and of interpreting them to the public. The existence of the post is a great stimulus to the zeal and ambition of zoologists and geologists.

The arguments alleged in favor of the recommendation are trivial. It is stated that a former director was allowed by the trustees to leave the administrative details to the member of the clerical staff whom it is proposed to promote, that he performed these duties with ability, and during the tenure of the present director retained and extended his powers. It is urged that the tenure of the new director would be short, as he would have to retire in two years under the age limit. It is pleaded that promotion would entitle him to a larger pension, and that he need not be called director, but only acting-director.

Plainly, if the assistant secretary be the only man who knows the details of administration, it is important that the permanent director should be appointed at once, in order to have the opportunity of learning them before taking them over. In actual fact there is nothing in the administrative work of the directorship that could not be learned in a few weeks or months by any person of ordinary intelligence. At least two of the present keepers are eligible for the vacancy, have attained the necessary scientific standing, and have ample experience of the museum itself. To pass over these or several eminent and eligible men not on the staff in favor of one of the ordinary office staff would be an affront to scientific men and of grave detriment to science.

THE INYO RANGE AND THE MOUNT WHITNEY REGION

The Inyo Range, the Mount Whitney region and Owens Valley, which lies between these two ranges, in eastern California, are described in a report just issued by the United States Geological Survey, as Professional Paper 110 by Adolf Knopf. This region is off the main lines of travel and is not so well known as other parts of the state, but when the roads and railway facilities are improved, Owens Valley, which affords the easiest access to the region, will certainly become famous for its magnificent scenery. The Sierra Nevada, which reaches its highest point in Mount Whitney, forms the west wall of Owens Valley, and as it rises abruptly above the valley without intervening foothills the range displays its majestic height far more imposingly here than anywhere else along its course. The top of the Sierra Nevada is readily accessible by trails that start from the pleasant towns of Lone Pine, Independence, Big Pine and Bishop. Good roads extend into the heart of the range from Bishop, the chief town in Owens Valley, so that an automobile trip of hardly more than an hour will take the traveler to the headwaters of Bishop Creek, whose profoundly glaciated canyons and spacious amphitheaters are among the most impressive in the entire range. The country west of the crest of this part of the Sierra Nevada is included in the proposed Roosevelt National Park.

The region is rich in mineral resources—silver, lead, zinc, tungsten, gold and marble—and the waters of Owens Lake yield soda and other chemicals. The mines at Cerro Gordo, in the Inyo Range, have produced more silver-lead ore than any other mine in California, their output of base bullion between 1869 and 1877 amounting to $7,000,000. After those early flush times the mines long lay idle, but in recent years they have been reopened, and Cerro Gordo has again become California's foremost producer of lead ore.

In 1913 large bodies of tungsten ore were discovered in the Tungsten Hills, west of Bishop. They remained practically unknown until the spring of 1916, when outside interests bought them and began to develop them energetically. By midsummer two mills had been completed and were in active operation, and the district has since supplied a large quantity of tungsten. Geologic conditions similar to those in the Tungsten Hills prevail over a wide extent of country along the east slope of the Sierra Nevada. The places of contact of the intrusive granites with other rock, shown in the geologic maps accompanying the paper, are the most likely places to prospect for other similar bodies of tungsten ore.

THE JOURNAL OF "NATURAL HISTORY"

THE *Journal of the American Museum of Natural History* will hereafter be known as *Natural History*, being edited as hitherto by Miss Mary Cynthia Dickerson, curator of woods and forestry. The change is announced as follows:

Attention is called to the change in title of this magazine from *American Museum Journal* to the old, honorable and historical name *Natural History*. A change has been contemplated for two years or more, partly to avoid confusion with other publications known as "Museum Journals" and partly because the magazine for these years has not restricted itself to a consideration of the American Museum's work and interests. As expressed many times by the editor in letters to contributors, the magazine would like to feel that it stands as a medium of expression between authoritative science in America and the people, a place for publication of readable articles on the results of the scientific research and thought of the nation for people who are not technically trained. These people have neither time nor desire to pore over technical, unreadable articles, but nevertheless are intelligently, practically and often profoundly interested. *Natural History* would like to stand for the highest type of authoritative natural history, expressed by the investigators themselves, by explorers, by the accurate observers in laboratory or field. In addition it desires to interpret the technical publications of our scientific thinkers, if not by popular articles by the same authors, then through reviews by other well-known scientific thinkers, these "reviews" being, as suggested, readable discussions of the given subject apropos of the technical work. It would also of course report phases of the educational work being accomplished by the scientific departments of the United States government and by the various scientific institutions of the country, especially those of the museum type.

There has been so much shallow, inaccurate, "popular" science, nature study and natural history, written by persons untrained in science and with distorted imaginations, that a prejudice still remains in the minds of some scientists against putting their observations and conclusions, even when of great value for the layman, into readable form. But the time of such suspicion and condemnation against the mere form of expression of an idea is well-nigh past, and the greatest scientific men of the country are daily proving their willingness and desire to write in a way to be understood not only by the trained technical man, but also by the man with no knowledge of the shorthand of the scientific vocabulary.

We need especially to have a knowledge of nature and science to-day. The day of necessity has come for conservation of the world's natural resources and preservation of animals fast becoming extinct; there is seen approaching the time of conscious control of evolution; and just ordinary culture demands in the present decade knowledge of science in addition to what it has always demanded in literature, music and art. And these reasons do not take account of the added joy in life that comes from a knowledge of nature. We people of to-day need to know the book of the earth, to study it as a Bible, feeling the divinity in it. *Natural History* hopes to meet this need in part.

DEGREES IN PUBLIC HEALTH

IN view of the importance of arriving at some measure of standardization for the various degrees and certificates offered in the field of public health, Yale University invited a group of representatives from neighboring universities to confer in regard to the matter at New Haven on February 28, 1919. Johns Hopkins University was represented by Dr. W. H. Welch, the Massachusetts Institute of Technology by Professor W. T. Sedgwick, Harvard University by Dr. M. J. Rosenau, New York University by W. H. Park, and the University of Pennsylvania by Dr. H. F. Smyth; while Yale University was repre-

sented by a special committee from the Graduate School, including Professor S. E. Barney. Professor L. B. Mendel, Professor L. F. Winternitz and Professor C.-E. A. Winslow.

After very full discussion of the various points involved the following resolutions were unanimously adopted:

1. That the degree of Doctor of Public Health (for which the abbreviation should be Dr.P.H.) for graduates in medicine should normally be awarded after two years of work done under academic direction, of which one year at least should be in residence; and that the requirements for the degree should include class work, practical field work, and an essay based on individual study of a particular problem.

2. That the degree of Doctor of Philosophy or Doctor of Science in Public Health or Hygiene should be conferred upon students who hold the bachelor's degree from a college or technical school of recognized standing, and have satisfactorily completed not less than three years of graduate study. It is understood that this degree is based upon the fundamental sciences associated with hygiene and public health, including a knowledge of physics, chemistry, general biology, anatomy, physiology, physiological chemistry, pathology and bacteriology, in addition to the thesis and other usual requirements for the Ph.D .or Sc.D degree.

3. That the Certificate in Public Health should be granted for not less than one academic year of work to those who have received a bachelor's degree from a recognized college or technical school, or have satisfactorily completed two years of work in a recognized medical school, provided they have previously pursued satisfactory courses in physics, chemistry, general biology and general bacteriology.

4. That the degree of Bachelor of Science in Public Health or Hygiene should be given for the completion of a four years course, the last two years of which have been devoted to the fundamental sciences associated with hygiene and public health.

5. That the authorities having the appointment of health officials be urged to give preference so far as possible to persons holding degrees or certificates in public health or hygiene.

SCIENTIFIC NOTES AND NEWS

Sir J. J. Thomson has expressed his desire to resign the Cavendish professorship of experimental physics at the University of Cambridge, but has offered to continue his services in the promotion and direction of research work in physics without stipend.

Colonel William H. Welch, of the Johns Hopkins University, has sailed for France, where he will attend the health conference of the International Red Cross.

The following fifteen candidates have been nominated by the council of the Royal Society for election into the society: Professor F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr. G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Dr. C. G. Seligman, Professor B. D. Steele, Major G. I. Taylor, Professor G. N. Watson, Dr. J. C. Willis and Professor T. B. Wood.

Fellows of the Royal Society of Edinburgh have been elected as follows: Dr. A. R. Cushny, Dr. W. J. Dundus, Dr. R. O. Morris, Dr. T. S. Patterson, Mr. B. D. Porritt, Mr. A. H. Roberts, Mr. W. A. Robertson, Dr. A. Scott, Dr. A. R. Scott, Mr. W. W. Smith and Captain D. A. Stevenson.

Lieutenant General Sir Charles H. Burtchaell, K.C.B., director-general of the British Army Medical Service in France, has received the honorary degree of LL.D. of the University of Dublin, from which he graduated in 1889. He has also received the honorary fellowship of the Royal College of Surgeons in Ireland.

Dr. William K. Gregory, associate in paleontology in the American Museum of Natural History, New York, was recently elected a corresponding member of the Zoological Society of London.

Major John W. Churchman, M.R.C., professor of surgery at Yale University, has been named "Officier de l'Instruction Publique" by the French government in recognition of his services as Medicin chef of Hospital militaire 32bis, Passy, France. during 1916.

Dr. M. G. Seelig, professor of surgery in the medical school of St. Louis University, has received his honorable discharge from the

Army, and has accepted the commission of colonel in the Medical Section of the Officers' Reserve Corps.

Among the members of the University of California faculty who have been on war leave and have now returned to their work at the university are: W. B. Herms, associate professor of parasitology; G. R. Stewart, assistant professor of agricultural chemistry; A. W. Christie, instructor in agricultural chemistry, and W. D. Norton, H. E. Drobish and F. T. Murphy, assistants in agricultural extension.

The laboratory of forest pathology of the Bureau of Plant Industry, U. S. Department of Agriculture, formerly located at Missoula, Montana, has been permanently established in Spokane, Washington, with Dr. James R. Weir in charge.

Dr. H. M. Hall, who recently resigned as associate professor of economic botany in the University of California, has accepted a position with the Carnegie Institution of Washington. The vacancy in the department of botany at Berkeley has been filled by the appointment of Dr. F. J. Smiley, who has been associate professor of botany and geology in Occidental College.

Mr. C. D. Shane has been appointed assistant in the Lick Observatory, University of California.

Dr. Lee R. Dice (California, 1915), formerly zoologist of the Experiment Station and instructor in zoology at Kansas State Agricultural College, and later assistant professor of biology at Montana State University, has accepted the position of curator of mammals in the Museum of Zoology, University of Michigan.

Mr. Charles Howard Richardson, recently a research chemist with the Röhm and Haas Chemical Company, Bristol, Pa., has been appointed specialist in insect physiology, Bureau of Entomology, Washington, D. C.

Dr. Chester N. Myers, organic chemist of the Hygienic Laboratory, Public Health Service, has resigned to organize a research laboratory for H. A. Metz and Company, New York.

Dr. H. J. Spinden, of the anthropology department of the American Museum, has returned from an archeological and ethnological expedition to Central America and Columbia.

A coast and Geodetic Survey party, under the direction of O. W. Swainson, is at work on the triangulation and topographic surveying of the Virgin Islands, recently acquired from Denmark.

Professor L. C. Graton, who has been in New York as secretary of the Copper Producers' Committee, one of the few war committees for industrial control organized and administered by the concerned industry itself though acting under authority of the War Industries Board, will soon return to Harvard University to take up the work in mining geology and to revive the secondary enrichment investigation. Before leaving New York, he will repeat at Columbia the series of lectures he gave there last year on oxidation and secondary enrichment.

Mr. Gerald H. Thayer gave an illustrated lecture on "Camouflage and Protective Animal Coloration" at the New York State College of Forestry at Syracuse on March 18.

The seventh Harvey Society lecture of the present series will be by Dr. Stewart Paton, of Princeton University, formerly major, U. S. A., on "Human Behavior in War and Peace" at the New York Academy of Medicine on Saturday evening, April 12.

On March 25, an exhibition of motion pictures of plant life was held at the Brooklyn Botanic Garden under the joint auspices of the Torrey Botanical Club and the Botanic Garden. Among the subjects illustrated were the penetration of the tissue of a potato tuber by the hypha of the parasitic fungus that causes the potato leak disease, and bridge grafting to save fruit trees which have been girdled by rodents or otherwise. The films were explained by Dr. R. B. Harvey, of the Department of Agriculture.

Dr. Leonard Hill, F.R.S., delivered a lecture on the atmospheric conditions which affect health, before the Royal Meteorological Society on March 19, in the lecture room of the Geo-

logical Society. The chair was taken by Sir Napier Shaw, F.R.S.

A MEMORIAL service in honor of the late President C. R. Van Hise will be held by University of Wisconsin late in April, according to plans now in preparation. The speakers will be: Professor T. C. Chamberlin, of the University of Chicago, who will speak on Dr. Van Hise's relation to science; Dr. Albert Shaw, of *The Review of Reviews*, who will speak on Dr. Van Hise's relation to the public, and President E. A. Brige, of the university, who will speak on Dr. Van Hise's relation to the university.

DR. FREDERICK DU CANE GODMAN, the distinguished English naturalist, died on February 19.

J. J. T. SCHLŒSING, professor of agricultural chemistry in the Paris Conservatoire des Arts et Métiers, died on February 8 at the age of ninety-four years.

ANDRÉ CHANTEMESSE, professor of hygiene in the Paris faculty of medicine and inspector general of sanitary services, has died in his sixty-fifth year.

ANDREW MELVILLE PATERSON, professor of anatomy at the University of Liverpool, died on February 13, aged fifty-six years.

THE British Association for the Advancement of Science will resume its series of annual meetings this year at Bournemouth from September 9 to 13, under the presidency of the Hon. Sir Charles Parsons.

A CONSIDERABLE fund has been given to Montefiore Home and Hospital, Gun Hill Road, New York City, the income of which is to be devoted to medical research independent of the hospital laboratory work. The selection of a director of research is at present under consideration and is in the hands of the laboratory committee.

THE ninth session of the Marine Biological Laboratory at Laguna Beach, California, will begin on June 25 and last six weeks. General courses in marine zoology, botany and entomology will be given. There are eight small private rooms for the use of special investigators. Copies of the announcement may be obtained by writing to the Department of Zoology, Pomona College, Claremont, California.

UNIVERSITY AND EDUCATIONAL NEWS

DR. J. B. HURRY has offered to increase the value of the Michael Foster research studentship in physiology, founded by him at the University of Cambridge in 1912, and tenable biennially, from a hundred guineas to £200.

DR. WITHROW MORSE, of the Michael Reese Hospital at Chicago, has received an appointment as professor of physiological chemistry in the medical school of the University of West Virginia, Morgantown.

DR. EUGENE L. PORTER, instructor in physiology in the University of Chicago, has been appointed assistant professor of physiology at the Western Reserve University Medical School.

DR. FRANK J. SMILEY, has been appointed assistant professor of economic botany and assistant botanist in the Agricultural Experiment Station, University of California.

THE Manchester City Council has approved the appointment of Arthur James Turner, to the chair of textile technology in the College of Technology, Manchester. Professor Turner will be assisted in conducting the work of his department by colleagues who are practical experts in various branches of the textile industries.

DISCUSSION AND CORRESPONDENCE

"OLD AGE" OF CHEMICAL ELEMENTS

TO THE EDITOR OF SCIENCE: In his presidential address Professor Richards discussed the interesting problem of radioactive lead.[1] The present conception regarding the structure of atoms and the theory of electrons seems to indicate that the chemical elements may be subject to "old age." According to this hypothesis "common" lead possessed eons ago, probably at the time of the formation of the earth, an atomic weight of 206.08 and density of 11.27 and by slowing up in the speed of its electrons increased its

[1] SCIENCE, 49, p. 1, 1919.

atomic weight to 207.19 and density to 11.34. Similarly "neo" lead, or freshly created lead, formed by radio-active disintegration, would very slowly increase its mass and eons hence have a higher atomic weight and density.

All other elements should be subject to an increase in mass and it could therefore be predicted that *e. g.*, helium of the atmosphere and of minerals will have an "atomic weight" which is .0214 higher than the atomic weight of helium from radioactive disintegration, that is: there should be an "old" or "common" helium with atomic weight of about 3.94, and a "neo" helium of atomic weight 3.92.

There is at present no evidence for the fallacy of such a speculation, in fact it seems to be supported by certain widely different phenomena to wit:

(*a*) *Radio-activity.*—The difference in the atomic weights of "leads" is explained in a plausible way. It is a safe guess to predict that common lead can not be separated. While a mixture of common and radioactive lead might be separated by fractional diffusion.

(*b*) *Astro-physics.*—The stellar evolution, revealed by characteristic types of stellar and nebular spectra, points to a close relationship between the constituents of celestial bodies and the periodic law. This indicates an evolution of chemical elements following the periodic system.

(*c*) *Geo-chemistry.*—Here the remarkable fact is shown that over 99 per cent. of the elements upon the known earth surface are those of low atomic weight. These elements occupy neighboring places in the periodic system which seem to indicate that the earth has reached a certain definite stage of evolution, practically halfway of the third period in the periodic system.

(*d*) *Bio-chemistry.*—From 96–99.5 per cent. of all living matter is composed of the four elements C, H, O and N, all four being neighbors in the periodic system. The other elements essential to life are closely grouped around.

Therefore is it not possible that biological evolution follows stellar evolution, and stellar evolution follows chemical evolution? If stellar and chemical evolution go hand in hand, then the physical, chemical and biological condition of a celestial body will depend entirely upon its age.

Where is the evidence that the elements of to-day were eons ago the same substances and preserved their properties unaltered? It is possible that the electrons of the atom might very slowly lessen their orbital motion and thereby attract and hold additional free electrons thus increasing in valency and mass. Thus, *e. g.*, a sodium-atom by catching an electron would increase in its valency and become a magnesium-atom. Magnesium in time transmutates into aluminum and so on.

Just as the astronomical experience of mankind is recognized to be a snapshot of the universe, so all chemical and physical knowledge of man is the limited inventory, taken during an infinitesimal fraction of eternity.

INGO W. D. HACKH

BERKELEY, CAL.,
January 22, 1919

DESICCATED VEGETABLES

AN admirable exposition of the anhydrous food industry has recently appeared in a government bulletin entitled "Relation of Dehydration to Agriculture" and written by Major S. C. Prescott. After reading this paper one can not fail to come to the conclusion that the preparation of dried foods is destined to become a very important industry. However, before such an industry can yield the maximum return it is essential that the eaters of the dried foods be scientifically assured that desiccated foods possess proper nutritive value. Some such investigations have been made but there is a need for very comprehensive studies.

It is a matter of common knowledge that desiccated vegetables, for example, will assume a form closely approaching that of the fresh vegetable after having been immersed in water for a few hours. This fact is often cited as demonstrating that there has been no alteration in the structure of the vegetable cell during the dehydration process. However, if we

remove the swollen vegetable from the water and permit it to remain at room temperature for twenty-four to thirty-six hours *it will return to its anhydrous state.* This phenomenon, it seems to me, stamps the anhydrous product as an entirely different product, structurally, from the fresh product, but does not necessarily indicate any lowering in food value. In other words a fresh vegetable holds its water much more tenaciously than does a dehydrated vegetable which has had its water removed and has subsequently been immersed in water and made to assume a form closely approximating that of the fresh vegetable. Is the failure of the anhydrous vegetable to retain its water to the same degree as the fresh vegetable due to the fact that the drying has brought about some change in the colloids of the vegetable cells which lowers their power to hold water? Or does the removal of salts through the "soaking" process lower the imbibition power of the colloids? Or is there some other answer? An explanation from our friends the physical chemists would be in order.

The above phenomenon was called to my attention by Mr. Charles Denby of the War Trade Board and Mr. Daniel Moreau Barringer both of whom are much interested in the general problem of food desiccation.

PHILIP B. HAWK
JEFFERSON MEDICAL COLLEGE,
PHILADELPHIA

NONSILVERABLE CONTAINERS FOR SILVERING MIRRORS

TO THE EDITOR OF SCIENCE: In connection with recent contributions to your columns under the title "Nonsilverable Containers for Silvering Mirrors" the writer may be permitted to record an observation made several years ago. This was that silvering solution could not be made to deposit on black amorphous selenium, although it coated the walls of the glass vessel in which the piece of selenium was placed. The converse of this experiment, namely silvering a piece of glass in a vessel lined with selenium, was not tried, but would appear to offer the solution of the problem of a container that will not attract silver.

HERBERT E. IVES

AD REM OF A HISTORY OF SCIENCES IN THE UNITED STATES

IN the long years of my labors in scientific reference work I found myself greatly hampered by the lack of an available source history of the different branches of sciences, especially of the exact sciences, in the United States. There are three important contributions in this field, all written by the late George Brown Goode: "The Origin of the National Scientific and Educational Institutions of the United States," 1890; "The Beginnings of Natural History in America," 1886; and "The Beginnings of American Science," 1887. Nobody who is acquainted with these papers can withhold his admiration for Mr. Goode's painstaking work, but after all they are only stepping stones and cover only a limited period, and serve merely, as it was contemplated by Mr. Goode, as an outline.

The more interested I became in the matter the more I found myself impressed by the idea to see that this great lacuna should be filled. The best channel through which to accomplish this seemed to me to lay the matter before the American Association for the Advancement of Science, have it discussed there in its entirety, and if possible undertaken by the association or under the auspices of the association. The outbreak of the world war made it seem advisable to me to postpone my plan. A year or two ago I broached the subject with Dr. L. O. Howard, the permanent secretary of the association, who fell in with the idea and expressed his willingness to submit my suggestion to the committee on policy, whenever I should be ready to present it in concrete form. Last October when the end of the war seemed to be only a matter of months I thought the time had come for action. Therefore, I addressed on October 25th the following communication to Dr. L. O. Howard:

Dear Sir:

There is as yet no history of sciences in the United States showing the important and far-reaching participation of our men of science in the general development of science. Now seems to be the proper time to seriously consider such an undertaking, as the great world war has changed and

will change not only political history but science to such an extent, that a genetic and historical survey is imperative. Therefore, in my opinion, the period to be dealt with should begin with the earliest original contributions of American men of science to the different fields of knowledge and close with the beginning of the world war. What is achieved during the world war marks a beginning of a new epoch in our national scientific life and should be treated later on.

As the American Association for the Advancement of Science is the representative scientific body of the United States, it is only proper that the history of sciences in the United States should be undertaken and edited under the auspices of the association.

Therefore, I beg to ask you as permanent secretary of the association to submit this proposition at the next meeting of the association and have it voted upon.

If the association should vote in favor of the motion the next step would be to consider how to proceed in this matter. In regard to this I wish to make the following suggestions, either of which should be carried out.

The first one would be to appoint a historical committee for this special purpose, in which each section of the association should be represented by one member, in addition to which three members at large should be appointed by the president. The president and the permanent secretary should be members of this committee ex-officio. The president acts as presiding officer of the committee, but might delegate any member of the committee as acting chairman.

The second suggestion would be to add a new section called "The Historical Section," and let them formulate a plan and submit it to the association. This section should be a permanent one, having the same organization as the other sections. Its purpose should be to promote the study of the history of sciences in the United States.

This second suggestion should be voted on even if my plan for a history of sciences in the United States undertaken under the auspices of the Association should be vetoed.

In a personal interview Dr. Howard kindly informed me that he would submit my letter to the committee on policy which was to meet in November in Baltimore. As several members of the committee were unable to attend, the meeting was not held and the question came up before the committee on policy during the recent meeting of the association. At this meeting of the committee it was decided to propose, among others, the following change in the constitution: that a new section, called section K:[1] "Historical Science" be formed. This proposed change is to be voted on at the next meeting of the association in St. Louis, December, 1919.

I sincerely hope that the association will vote in favor of it. I want to raise only one objection, and that is the designation of the proposed section. "Historical science" seems to me not very appropriate and really covers an entirely different subject, or is at least open to doubt. In my opinion the wording "historical science" would rather refer to history as science, which is a cultural science, while the new section "K" should deal with the history of the different branches of exact sciences. In my suggestion submitted to the association I proposed as the name of the new section: "Historical Section." An afterthought shows me that this designation may be subjected to the same criticism. Therefore, I propose now as the proper designation of section "K" the name: "History of Science," which would express the contemplated work of the section without any doubt: "To promote the study of the history of sciences in the United States."

On the main point of my suggestion in regard to a "history of sciences in the United States undertaken and edited under the auspices of the American Association for the Advancement of Science," the committee has taken no action.

This gives me a certain liberty of action. I hope that this question may be aired at the next meeting at St. Louis; meanwhile I would like to bring the matter to the attention of our scientific men and institutions, and a discussion of the project in the columns of SCIENCE would be very welcome to me.

FELIX NEUMANN

ARMY MEDICAL MUSEUM AND LIBRARY,
WASHINGTON, D. C.

[1] Owing to a division of several sections a new lettering of the sections has to be adopted.

SCIENTIFIC BOOKS

Electroanalysis. By Edgar F. Smith. P. Blakiston's Son and Co., Philadelphia. 1918. Pp. 344, 47 figs.

This book is so well known that a brief mention of the fact that a new, sixth, edition of this national standard had appeared would suffice. Compared to the fifth edition which appeared in 1911, a number of additions to the text have been made, so that "in its present form there is presented the most recent and complete picture of the subject to which the book is devoted." "The book brings together all that has been found reliable, by the test of experience and offers simultaneously the latest results gathered in recent years from widely removed centers.''

The first edition of the book appeared at Philadelphia in 1890 and comprised 116 pages. In reviewing the book at that time Ira Remsen wrote:

> Chemists will find this little book an excellent guide to a knowledge of the methods of quantitative analysis by electrolysis. As the author has himself contributed not a little to our knowledge of these methods, he is especially prepared for a work of this kind.

Up to 1890 text-books on analytical chemistry paid very little if any attention to electrolytic methods. The appearance of Dr. Smith's book marked the opening of a new era in quantitative analysis. The book was welcomed by chemists throughout the country and abroad and within a very few years thousands of determinations were annually made by electrolytic methods.

In 1901 Smith and his students, notably F. F. Exner, introduced the rotating anode with high currents and high voltages. Determinations which had formerly required two to four hours were reduced to five to ten minutes —and the quantities that could be accurately determined were more than threefold the quantities by the older methods.

The adoption of electroanalytic methods has been so rapid and so widespread that to-day it is hard to find a laboratory that does not include a complete outfit for electrolytic determinations. Apparatus builders are now placing upon the market standard equipments, saving much time and expense.

The wide scope of the book as it appears to-day is evident from the following brief summary of the contents: The first part of the book is devoted to the selection and description of suitable apparatus, a historical sketch and a very clear outline of the important underlying theories. The second or special part of the book (about 250 pp.) is devoted to the determination and separation of metals, halogens and nitric acid; the use of the mercury cathode; the electroanalysis of natural sulfides, arsenides, chromite, etc. Among the most recent additions to the text may be mentioned the paragraph on the use of Gooch's platinum-coated glass in place of solid platinum, the quantitative determination of cobalt as Co_3O_4 from ammonium fluoride-nitric acid solutions; and the description of the improved double mercury cup in which "hundreds of halides have been successfully analyzed."

One of the characteristic features of Smith's book as compared with other books on analytical chemistry, is the inclusion in the text of tables recording in detail actual experiments carried out according to the methods suggested. Of interest and value, furthermore, are the detailed literature references, a welcome guide to all who care to investigate the subject more fully. There is no attempt made to supply a "recipe" for every determination and every separation. Where accurate methods have not yet been propounded it is frankly acknowledged that such are lacking. Perhaps, too little space is devoted to the rotating cathode, used to advantage at times in place of the rotating anode. In a number of the large commercial laboratories the rotating cathode has been chosen in preference to the rotating anode on account of simplicity of mechanical layout.

The subject matter throughout the book is presented in so masterful a style that it can not fail to inspire confidence not only in the young student but also in the analyst of "many and varied experiences." To the student, the teacher and the analyst the book is an indispensable guide. As a chemical publication

Smith's "Electroanalysis" will always remain one of the American classics.

Colin G. Fink

S. Yonkers, N. Y.

REPORT OF THE COMMITTEE ON GENERIC TYPES OF THE BOTANICAL SOCIETY OF AMERICA

At the recent meeting of the Botanical Society of America at Baltimore the appended report was submitted. The proposed regulations for fixing generic types were accepted with the suggestion that they be published and distributed among botanists for their consideration. These regulations, being a part of a proposed Code of Nomenclature, should await the formulation of the latter for final adoption. The second part of the report, dealing with the Permanent Committee on Nomenclature, was adopted and the action recommended was authorized.

A. S. Hitchcock

Bureau of Plant Industry,
Washington, D. C.

REPORT OF THE COMMITTEE ON GENERIC TYPES

At its last meeting the society authorized the president to appoint a committee of three upon Generic Types. The members appointed were N. L. Britton, A. S. Hitchcock (chairman) and B. L. Robinson. Dr. Robinson declined to serve and it was found impracticable to obtain a representative from the Gray Herbarium. The remaining members, after some preliminary work, felt that it would be desirable to have the committee enlarged to represent a wider field of American botany. They therefore asked the incoming president, Dr. Trelease, to appoint J. M. Greenman as the third member of the committee and to add two other members, Leroy Abrams and Witmer Stone. The president felt that he did not have authority to enlarge the committee but suggested that the committee ask Messrs. Abrams and Stone to cooperate with it. This was done and these two have served on the committee as if they were members, and the report herewith submitted has received their approval. The committee, as now constituted, represents botanical institutions at Washington, New York, St. Louis, Philadelphia, and on the Pacific Coast.

The members of the committee were first asked to indicate their attitude toward the question of type species. Should the application of generic names be determined by type species; or should a generic name be applied to a generic concept independent of particular species?

The prevailing opinion being in favor of type species, there was sent to the members of the committee, a circular outlining the methods which might be used for selecting type species. Wishing to obtain advice and cooperation from competent botanists throughout the country the circular was sent to about fifty members of the Botanical Society.

It was overwhelmingly established that the botanists were in favor of the two fundamental principles: (1) The application of generic names shall be determined by type species; (2) The type species shall be the species or one of the species included in the genus when originally published (publication of genera of seed plants dating from the issue of Linnæus' "Species Plantarum" in 1753). In addition the opinion was prevailingly in favor of rules approaching those finally agreed upon by the committee.

Circular 5 contained a set of proposed regulations for fixing generic types and a few minor changes were made, resulting in the regulations as included in our report.

The committee makes two recommendations, (1) the adoption of a set of regulations for fixing generic types, and (2) the appointment of a permanent committee on nomenclature.

REGULATIONS FOR FIXING GENERIC TYPES.

INTRODUCTION

Rules of nomenclature should commend themselves as being reasonable and they should be as definite in their application as is consistent with reasonableness. In preparing the regulations the committee consulted other codes of nomenclature, the most important of which are the following:

The International Code of Zoological Nomenclature (see Treas. Dept. Hygien. Lab. Bull. 24 by C. W. Stiles; same with appendix and summaries of opinions 1–67, extracted from Proc. 9th Internat. Zool. Congr. 1913, published by T. O. Smallwood. Opinions 1–67 were published by the Smithsonian Institution). Article 30 concerns generic types.

The Code of Nomenclature adopted by the American Ornithologists' Union. Canons 21–24 concern generic types.

The Entomological Code. Banks and Caudell. Par. 93–106 concern generic types.

International Rules of Botanical Nomenclature. Vienna, 1905. The question of types is not touched upon. The application of generic names is considered in Arts. 45–46.

The American Code of Botanical Nomenclature (see *Bull. Torrey Club,* 34: 167, 1907). Canon 15 concerns generic types.

Recognizing the impossibility of framing a set of rules which shall cover all cases, since all contingencies can not be foreseen, the regulations have been divided into rules and recommendations. Under the rules are included statements of general principles to which all generic nomenclature should conform when considered from the standpoint of the type concept. It is thought that the types indicated by these rules will be acceptable without question to the great majority of botanists.

In order to adapt the genera of the older botanists to the modern concept to types it is necessary for us now to select type species for those genera for which no type would be indicated under our present rules. Some codes attempt by means of detailed rules automatically to select type species, hoping thus to secure uniformity, definiteness and stability. As all difficulties in the application can not be foreseen, the results in some cases have been confusing and have tended to cast disrepute upon the rules. This committee has appreciated the desirability of framing a code which shall possess definiteness but has endeavored to secure this by giving to a committee judicial functions.

The second part of the regulations consists of a series of recommendations. These are fairly elastic and can be applied reasonably rather than arbitrarily. In a large majority of cases the results obtained would be unquestioned. There would be, however, a small number of cases, especially among Linnæan genera, in which competent botanists might arrive at different results. It is proposed that such cases should be referred to a permanent committee which shall investigate them and recommend decisions to this society. It is believed that by this method types of genera may be selected which will receive the approval of the great majority of botanists. We look forward to an international agreement upon the types of all genera, thus laying the foundation for stability in nomenclature.

The proposed regulations follow:

I. RULES

Article 1. The application of generic names shall be determined by type species.

Article 2. The type species shall be the species or one of the species included in the genus when originally published (publication of the genera of seed plants dating from the issue of Linnæus's "Species Pantarum" in 1753).

(*a*) If a genus includes but one species when originally published, this species is the type.

Article 3. When, in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as the type, regardless of other considerations.

(*a*) If *typicus* or *typus* is used as a new specific name for one of the species, this species shall be accepted as the type as if it were definitely designated.

Article 4. The publication of a new generic name as an avowed substitute for an earlier one does not change the type of the genus.

Article 5. If a genus, without an originally designated type, contains among its original species one with the generic name used as a specific name, either as a valid name or synonym, that species is to be accepted as the type.

Example.—The type species of Pentstemon

(Ait. Hort. Kew. 2: 360. 1789) is *Chelone Pentstemon* (L. Sp. Pl. 612. 1753; ed. 2. 850. 1763) because the later is cited as a synonym under one of the species of *Pentstemon.*

Article 6. If a genus, when originally published, includes more than one species, and no species is definitely designated as type, nor indicated according to Article 5, the choice of the type should accord with the following principles:

(*a*) Species inquirendae or species doubtfully referred to the genus, or mentioned as in any way exceptional are to be excluded from consideration in selecting the type.

(*b*) Genera of the first edition of Linnæus's "Species Plantarum" (1753) are usually typified through the citations given in the fifth edition of his "Genera Plantarum" (1754) except when inconsistent with the preceding articles.

Example.—Arundo (L. Sp. Pl. 81. 1753) is typified by *A. Donax* since this is the species figured by Scheuchzer in the plate cited by Linnæus (Gen. Pl. 35. 1754).

(*c*) Species which definitely disagree with the generic description (provided others agree), or which possess characters stated in the generic description as rare or unusual, are to be excluded from consideration in selecting the type.

II. Recommendations

Article 7. In the future it is recommended that authors of generic names definitely designate the type species; and that in the selection of types of genera previously published, but of which the type would not be indicated by the preceding articles, the following points be taken into consideration:

(*a*) The type species should usually be the species or one of the species which the author had chiefly in mind. This is often indicated by

1. A closer agreement with the generic description.

2. Certain species being figured (in the same work).

3. The specific name, such as *vulgaris, communis, medicinalis* or *officinalis.*

(*b*) The type species should usually be the one best known to the author. It may be assumed that an indigenous species (from the standpoint of the author), or an economic species, or one grown in a botanical garden and examined by the author, would usually represent an author's idea of a genus.

(*c*) In Linnæan genera the type should usually be chosen from those species included in the first technical use of the genus in pre-Linnæan literature.

Example.—The type species of *Andropogon* L. should be chosen from the two species included by Linnæus in the first use of the name (L. Fl. Leyd. 1740).

(*d*) The types of genera adopted through citations of non-binomial literature (with or without change of name) should usually be selected from those of the original species which received names in the first binomial publication.

Example.—Cypripedium (L. Sp. Pl. 951) is typified by *C. Calceolus.* Under *Cypripedium* (Gen. Pl. 408. 1754) Linnæus cites *Calceolus* Tourn. 249. Tournefort mentions 5 species, one of which is cited under *Cypripedium Calceolus* by Linnæus.

(*e*) The preceding conditions having been met, preference should be shown for a species which will retain the generic name in its most widely used sense, or for one which belongs to a division of the genus containing a larger number of species, or, especially in Linnæan genera, for the historically oldest species.

Example.—Phalaris L. is typified by *P. canariensis* because it is the only one of the 5 Linnæan species known to the older writers (such as Bauhin) by the name of *Phalaris,* so far as shown by the synonyms given by Linnæus.

(*f*) Among species equally eligible, the preference should be given to the first known to have been designated as the type.

(*g*) If it is impossible to select a type under the conditions mentioned above the first of equally eligible species should be chosen.

Permanent Committee on Nomenclature

1. It is recommended that the present committee be enlarged to 9 members and be made a standing committee on Botanical Nomencla-

ture, the two members who have acted in co-operation with the committee to be formally added to that body; and that the president of the Botanical Society appoint additional members, one with a special knowledge of the Bryophyta or Pteridophyta, one with a special knowledge of the Algæ, and two with a special knowledge of fungi.

2. This committee shall investigate doubtful or questioned cases, either upon its own initiative or in response to requests, and shall recommend decisions. It may prepare a code of Botanical Nomenclature and may, at regular meetings of the society, recommend changes or additions to the code. It is suggested that the committee undertake, as soon as practicable, the typifying of the Linnæan genera, as this must be the basis of all future work.

SPECIAL ARTICLES

TEMPERATURE AND VERTEBRÆ IN FISHES; A SUGGESTED TEST

In 1862, Dr. Günther[1] noted that in the family of Labridæ (Wrasse fishes) the tropical species had 24 $(10 + 14)$ vertebræ while those of temperate seas had a larger number, the increase being mainly in the caudal region.

In 1863, Dr. Gill showed that this generalization could be extended to other families, and that it was to "be considered in connection with the predominance in northern waters" of soft-rayed fishes" in which the increase in the number of vertebræ is a normal feature." This generalization thus included the herring, trout, salmon, smelt, cod, flounder and their relatives, and might have been extended to the sculpins, greenlings and other spiny-rayed fishes—northern types as well.

In 1864, Dr. Gill noted that the northern genus, *Sebastes,* with $12 + 19 = 31$ vertebræ showed a similar relation to its tropical relative *Scorpæna,* with $10 + 14 = 24$.

In various papers, the present writer has extended this generalization to numerous other families, raising it to the dignity of a "law." In general, among, spiny-rayed fishes, the tropical forms have the vertebræ $10 + 14$, the northern forms, fresh-water forms, pelagic species and deep-sea representatives a larger number. In the groups of soft-rayed fishes, the vertebræ in the tropics usually range higher than 24 (35 to 43) among flounders while the subarctic species all run higher (among flounders 49 to 65). The sub-Arctic blennies have the vertebræ 75 to 100, their tropical relatives 28 to 49. Some such relation exists in every group—eel-shaped fishes excepted. These have no northern representatives and in them the whole body is peculiarly modified in accordance with their mode of life.

The facts being fairly established we look next to its explanation. Dr. Gill states (1889) that "it is simply the expression of a fact which has no cause for its being now known." He further doubts whether it can ever be ascertained.

In my own first paper on the subject[2] I suggested that the larger numbers might be primitive, and that the smaller numbers (accompanied by corresponding increase in complexity of the individual vertebræ) were the result of specialization or "ichthyization," a process which in the favoring temperature, amid intense competition of the tropics and especially about coral-reefs, brought about the more perfect or fish-like fish.

I am now, however, inclined to accept Dr. Boulenger's suggestion that the increased numbers and the lack of specialization of parts is the result of a form of degeneration, and that the lower number is a primitive trait possessed by the ancestors of most of the higher bony-fishes.

One way of testing this has occurred to me. The genus *Sebastodes* and its near allies ("rock-cod") form a large part of the temperate fish-fauna of California and Japan. These stand intermediate in characters as well as in geography between the subarctic rose-fishes (*Sebastes, Sebastolobus,* etc.) and the tropical scorpion-fishes (*Scorpæna, Helicolenus,* etc.) with their derivatives and allies.

In *Sebastes,* the vertebræ are $12 + 19 = 31$; in *Sebastodes,* $12 + 15 = 27$, and in *Scorpæna,* $10 + 14 = 24$. The species of *Sebastes* and

[1] "Catalogue of the Fishes of the British Museum," Vol. IV.

[2] *Proc. U. S. Nat. Mus.,* XIV., 1891.

Sebastodes are viviparous, the young being developed internally and in multitudes, to be extruded when about two or three millimeters in length. The development of the young should indicate the phylogeny of the group. If the total number of vertebræ in *Sebastodes* is 24, we may infer with strong plausibility that *Scorpæna*, with its 24 vertebræ was the ancestral type. If the number is 31 we would grant this place to *Sebastes*. In either case, *Sebastodes* is intermediate.

Through the interest of Professor Edwin C. Starks, I have secured a number of young of a species of *Sebastodes* from Long Beach, California. These are very recently hatched, one to two millimeters in length. Vertebræ do not appear, but the muscular impressions which will correspond to them are 27 in number.

This agrees with the number of vertebræ in the adult of all the *Sebastodes* recorded. This test, therefore, fails to decide the question of origin, though it may be held to show that the separation of *Sebastodes* from *Sebastes* or from *Scorpæna* is really very old, and in spite of the strong resemblances of the forms concerned.

I may further note that all allies of *Scorpæna* with 24 vertebræ have 12 spines in the dorsal fin, *Sebastodes*, and its relatives with 27 vertebræ have 13, and *Sebastes*, with 30 or 31 vertebræ, has 15 or 16 dorsal spines, the numbers of fin rays corresponding in a degree to the number of vertebral segments.

David Starr Jordan

Since the above was in type, I have obtained from the diatomaceous shales of the Puente formation (Miocene) of Orange, California (E. E. Hadley coll.), a fossil fish apparently of the *Sebastodes* group. This specimen has the vertebræ about 32 in number, 10 + 20 being preserved. The head of the specimen is lost, but the fish must belong to the *Sebastinæ*, as no other forms unite the characters of stiff dorsal spines, anal rays III, 10, with small scales and the vertebræ more than 24. In other respects, this new genus (soon to be described and figured), seems nearest *Sebastosomus* Gill (*S. mystinus*). The discovery of this form is again not decisive, though it indicates the possibly primitive character of the *Sebastina* fishes having the larger numbers of vertebræ.

David Starr Jordan

THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

The fourth annual meeting of the American Association of Petroleum Geologists was held at the Adolphus Hotel, Dallas, Texas, on the 13 to the 15 of March. More than two hundred petroleum geologists and a great number of visitors were present from all portions of the United States, the association being especially honored by the presence of David White, chief geologist of the U. S. Geological Survey; I. C. White, state geologist of West Virginia; Ralph Arnold, valuation expert of the Internal Revenue Department of the U. S. Treasury, and Professor Chas. Schuchert, of Yale University.

The opening meeting of the association was called to order on Thursday morning by the president, Alexander Deussen. Gilbert H. Irish, of the Dallas Chamber of Commerce, delivered an address welcoming the geologists to Dallas. Short talks were made by Dr. David White, Dr. I. C. White; Dr. J. A. Udden, state geologist of Texas; W. F. Cummins; J. A. Taff, of San Francisco, and Leo Hager, of Houston.

The first technical session was held Thursday afternoon, attention being devoted to the geology of the oil producing districts of north central Texas. John A. Udden, chief geologist of the Sinclair Oil Company, read a paper dealing with the subsurface geology of the oil-producing districts of north central Texas, and accompanied his paper by a set of well samples and slides of the formations penetrated in some of the wells of north central Texas. Chas. R. Eckes, chief geologist of the Texas Company, gave a description of cuttings from the Duffer well of the Texas Company at Ranger, and displayed a set of samples from this well. F. B. Plummer, of the Roxana Petroleum Company, gave a description of the cuttings from the Goode well of the Roxana Company, in Young County, and the Dye well in Palo Pinto County. Wallace E. Pratt, chief geologist of the Humble Oil & Refining Company, read a paper entitled "Notes on structure of surface rocks as related to subsurface structure and petroleum accumulation in north Texas." Dr. David White read a paper by G. H. Girty, on the "Bend formation and its

correlation." Dr. Girty pointed out that the lower part of the Bend Series of the Bend shale proper belonged to the Mississippian, and the upper part of the Bend, including the Marble Falls limestone and the Smithwick shale, belonged in the Pennsylvanian, with an unconformity between the Bend shale and the Marble Falls limestone.

At 8:15 in the evening a popular meeting was held in the auditorium of Municipal Building, Dr. I. C. White presiding. A large contingent of townspeople were in attendance. The session was addressed by Dr. David White, who made a plea for the accumulation of petroleum reserves in foreign countries by the American companies so that the future of the American oil industry would be assured. Dr. J. A. Udden read a paper on oil-bearing formations in Texas, and Mr. M. L. Fuller, chief geologist of the Sun Company, delivered an illustrated lecture on China.

On Friday morning papers were read by Dr. J. W. Beede, of the bureau of economic geology of the University of Texas, on "Notes on the structures and oil showings in the Red Rocks of Coke County, Texas," by J. A. Udden, on "Observations on two deep borings on the Balcones Faults," and by M. L. Fuller, "On the water problems of the Bend series, and its effect on the future production and flooding of oil sands." T. W. Gregory, of the U. S. Fuel Administration, read a paper on "Gas conservation and distribution under the U. S. Fuel Administration."

On Friday afternoon papers were read by W. L. Matteson, giving "A review of developments in the central Texas oil fields," one by Walter R. Berger, of the Empire Gas & Fuel Company, on the "Extent and interpretation of the Hogshooter Gas Sand," a paper by Dr. Raymond B. Moore, state geologist of Kansas, on the "Correlation of the Bend." Dr. Moore's conclusions were different from those of Dr. Girty's, the collections made by Dr. Moore, for the Roxana Petroleum Company, indicating that the lower Bend, or the Bend shale proper, belongs to the Pennsylvania instead of the Mississippian. Sidney Powers read a paper on the "Geologic work of the American Expeditionary Forces." The afternoon session was concluded by a paper by Dr. Ed. Bloesch, on "Unconformities in Oklahoma."

Friday evening a banquet was tendered the association and the oil producers by the Dallas Chamber of Commerce & Manufacturer's Association in the junior ball room of the Adolphus Hotel. The meeting was addressed by Ralph Arnold, who outlined the policy of the federal government in the matter of valuation and taxation of oil properties. Mr. Arnold's address was followed by two minute talks by F. W. Shaw, David White, Chester Washburne, Judge Greer, attorney for the Magnolia Company, J. Edgar Pew, vice-president of the Sun Company, and others.

Saturday morning was devoted to a symposium on valuation methods, Dr. I. C. White presiding. Papers were read by Ralph Arnold on "Problems of oil lease valuation," by Carl H. Beall on "Factors in the valuation of oil lands," by Professor Roswell H. Johnson on "Decline curve methods," and by E. W. Shaw, of the U. S. Geological Survey, on "Valuation of gas properties."

Saturday afternoon a paper was read by Mr. E. H. Sellards, of the bureau of economic geology, University of Texas, on "Structural conditions in the oil fields of Bexar County, Texas." Dr. Schuchert gave an illustrated lecture on contacts, and Professor Roswell H. Johnson presented a "Statistical investigation of the influence of structure on oil and gas production in the Osage Nations."

The following papers were read by title:

D. F. MacDonald, "Notes on the stratigraphy of Panama and Costa Rica."

Geo. E. Burton, "Design for a log meter."

G. Sherburne Rogers, "Oil field waters."

J. W. Bostick, "The Saratoga, Texas, oil field."

Earl A. Trager, "Laboratory methods for the examination of well cuttings."

Robert T. Hill, "History of geologic exploration in the southwest."

After the reading of these papers, the business meeting of the association was held, and the following officers were elected for the coming year:

Dr. I. C. White, *President*.
Irving Perrine, of Hutchinson, Kansas, *Vice-president*.
Professor C. E. Decker, University of Oklahoma, *Secretary-Treasurer*.
Chas. H. Taylor, *Editor*.

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THE UNIFICATION OF AMERICAN BOTANY[1]

A glance at the history of botany in America shows that on several occasions special branches of the science have attained prominence, have separated from the parent stock and taken independent root. These offspring are now counted as separate sciences which yield little or no allegiance to the parent stock, and whose devotees no longer call themselves botanists. As examples we may mention bacteriology, forestry and the group of agricultural sciences represented by agronomy and horticulture—all subjects essentially botanical, with large and active corps of workers, but belonging to botany no longer.

This dissociation is undoubtedly the natural result of the growth of botany and the development of its several fields, each of which, as it assumes a position of special importance, develops more or less of autonomy and sometimes independence. Other sciences show the same tendency, and I shall not attempt to decide whether botany shows this trend toward dissociation to an exceptional degree. The questions of immediate importance to us are: What are the causes of this dissociation? Are they still operative? What new developments may be expected? How far can the process go without serious injury to botany in general? Can the tendency be overcome in whole or in part? And if so, how? It is fitting that these questions should receive the serious consideration of all botanists at this time for the future is heavy with possibilities. The changes of reconstruction may prove to be more fundamental than those of war, and the responsibility

[1] Invitation paper before Section G of the American Association for the Advancement of Science, in joint session with the Botanical Society of America and the American Phytopathological Society, Baltimore, December 26, 1918.

for American botany during this period of flux rests upon the botanists themselves.

That the tendency amongst botanists toward dissociation is too strong to be disregarded is shown by an examination of the recent botanical programs of these winter meetings in comparison with those of a few years ago. Formerly all botanists met with Section G of the American Association for the Advancement of Science, and with the Botanical Society of America for the reading of papers on miscellaneous botanical subjects. Now, the plant pathologists, the geneticists and the ecologists have independent societies; the physiologists and systematists have separate sections of the Botanical Society with independent programs; and still other groups of botanists are beginning to request recognition and to urge that special sessions be devoted to their subjects. The grouping of papers according to subject matter and the formation of special programs are made necessary by the rapid increase in the number of papers presented, and doubtless are desirable in every way. The formation of different sections by the Botanical Society of America, and even the launching of independent societies by various groups of botanists, are the natural results of rapidly mounting numbers and of increasing specialization.

There is no question but that the evolution of our winter programs indicates healthy growth, yet we must recognize the lurking danger, for we see here one evidence of the centrifugal tendency amongst botanists. Separate programs denote and foster a concentration of effort along special lines. They are one sign of our inclination to segregate into groups, the special subjects in which we are interested acting as the foci of attraction. This segregation, within proper limits, undoubtedly makes for efficiency, but we must take care that it does not lead to undue slackening of interest in other botanical fields than our own, to loss of perspective and to inability to grasp other points of view. If this occurs we shall have crossed the danger line, ultimate estrangement amongst botanists becomes a mere matter of time, and efficiency will give place to disunion and narrowness. Botanical science could not then be compared with a healthy tree surrounded by vigorous offspring in the shape of subsciences; rather would it be likened to an ancient trunk denuded of many of its most important branches which have struck root for themselves and are now selfishly competing with one another and with the impoverished parent stem.

Our problem then is to preserve the unity of American botany without losing the benefits of specialization. It is the old problem of controlling and directing the vital forces which underlie growth and development that they may make for efficiency and strength rather than for disunion and weakness.

I believe there is one factor more potent than any other in promoting disunion amongst botanists. That factor is not the fundamental scientific importance of a given field of botany, nor the speed of its development. We have seen the rise to importance of one subject after another without witnessing their withdrawal from the botanical hearthstone. It is not the development of a peculiar and highly specialized technique, nor the concentration of interest in a particular group of plants. Neither is it mere number of workers in a given field, nor close affiliation with non-botanical subjects. All these factors contribute to dissociation *within* the ranks of botanists, but do not necessarily lead to rupture of those ranks. Perhaps not all combined are so potent in this respect as is economics. Whenever any branch of botany becomes of especial economic importance its centrifugal tendency is enormously increased. The general public is then interested and becomes instrumental in determining the course of development. There is a new and greatly enlarged staff of workers, many of whom have not received orthodox botanical training. These workers in the new field of applied botany lose the isolation of the pure scientist, and come more closely in touch with the problems of human life. New methods of thought appear and new standards of value arise. While the applied botanist is developing the ideals of service to his fellow men, he often over-emphasizes the importance of his own field, loses his catholic interest in botany in

general, and then gradually withdraws from the fellowship of pure botanists.

But the pure botanist is not without fault, for he too often matches the narrowness of the applied botanist with his own intolerance. I have seen mycologists bored to extinction while pathologists excitedly discussed the effects of a serious outbreak of late blight of potatoes, and only become interested when the discussion turned to the morphology of *Phytophthora infestans*. Surely no science is more closely bound up with human life than the study of plants, which furnish us food and drink, shelter and clothing, and supply so many of our other needs, physical, intellectual and esthetical. Yet botany has appeared to dread the economic taint and has seemingly endeavored to keep its skirts free from the stain of the soil in which plants grow. Certainly she has allowed the applied branches to struggle on without the full benefit of a mother's firm yet tender guidance, and too often has repaid the waywardness of the child with aloofness and neglect.

Separations which have occurred already in the botanical field probably were inevitable, and perhaps were for the best interests of the subjects concerned. But there can be no doubt that further divisions would be disastrous. More than that, at this time when botany should face the future with a united front, we can not permit the forces of disunion to go unchecked and any divergences which now exist amongst us must be abated. Such divergences do exist and if neglected will increase in extent. The immediate danger point is found, I believe, in plant pathology. That pathologists have been growing apart from other botanists there can be no doubt, and I have not yet observed any extensive effort on either side to stay the process. Certain conditions surround plant pathology unlike those pertaining to any other branch of botanical science, and some of these conditions make for disunion. In briefly presenting some of these features for your consideration this afternoon I will speak of pathologists on the one hand and of botanists on the other. This distinction is merely for convenience. Pathologists are botanists still, and it is my earnest hope that they may always remain so.

Plant pathologists constitute the largest single group of botanical workers, and the only large group directly connected with the economic field. The latest printed lists of members show 384 names in the roll of the American Phytopathological Society, and 630 names in that of the Botanical Society of America. One hundred and eighty names are common to both societies, making a total of 834 names on both rolls. Of these 834 names, 384 or 46 per cent. belong to pathologists, or to botanists, largely mycologists, who are sufficiently interested in pathology to join the American Phytopathological Society. These facts are worthy of attention. Pathology is not only one division of botany, it is by far the largest division, it is a young division, it is growing very rapidly and must continue to grow rapidly in the future. As a result most pathologists are young, with the zeal and enthusiasm of youth and of expanding opportunity.

Another important fact to be noted is that pathologists constitute a remarkably homogeneous group as compared with the diversity amongst botanists. Plant diseases show almost infinite variety and the problems they present are equally varied. Yet whatever their previous training and experience, whatever the requirements of their particular problems, all pathologists speak the same language and think in the same terms. All recognize that they are working toward the same end on different phases of the great disease problem. Hence there has arisen a community of interest amongst pathologists unknown among botanists and impossible for them to develop. Pathologists are rapidly forming an esprit de corps which is an asset of the greatest value and will prove to be a powerful factor in future development.

The rapid growth of phytopathology in importance during the past few years has brought the pathologist more and more closely in touch with both producer and consumer of plant products. The world war has greatly increased his responsibilities in connection with the food supply. He has taken his place on the battle front of world action and more and more is losing the independence of the botanist as he

takes up the life of public service. He is drifting away from botanical fellowship, for circumstances have given him little time for mental adjustment, and for the throwing out of adequate anchors. So we have at the present time, this large and rapid growing body of botanical workers, remarkably homogeneous, with unusual esprit de corps, closely in touch with human life, which is drifting steadily away from the botanical standards and ideals of the past. Can either botanists or pathologists permit the drift to continue?

Pathologists are already losing much through lack of close association with other botanists. The demands upon pathologists have been many this past year on account of increased responsibilities, while their ranks have been depleted by the call of many of their number to military service. Teaching, laboratory research, field work, the ever-increasing demands of the extension service, all combine to give the harassed pathologist no respite. The future promises little hope for greater leisure because the world requires food. Although pathology is receiving increased financial support and additional helpers are rallying to her assistance, these additions barely keep pace with the ever mounting responsibilities. The pathologist must look forward to a life harassed by the multiplicity of problems insistently pressing for attention. Oftentimes he will be forced into print prematurely due to public and administrative requirements. Therefore, he must guard constantly against becoming hasty, superficial and narrow. He will need the broadening contact with the classical and fundamental work of other botanical fields. He will need the steadying influence of the greater leisure and consequent independence of the pure botanists. He will need their active assistance in the solution of his problems.

Botanists too have much to gain from close association with their pathological colleagues. Pathologists constitute the largest single group of botanists. They are virile and alert. They have the energy and spirit belonging to a young science. They possess the lofty ideals and contagious zeal of public service. They are in close touch with the throbbing pulse of human life and can furnish this valuable contact to other botanical workers. Botanists have watched the economic branches of their science develop one after another and slip away from their fellowship, while they themselves have stood by, either helpless or indifferent. This has gone on until many botanists now appear to regard applied botany as a thing apart, perhaps of a lower order, in which they may properly take only an academic interest. What an error! How can the virility of any subject be maintained except by human contact? Is not service the highest standard and the greatest activator? The value of any discovered truth is in the end determined by its usefulness, by its connection with other facts already known or yet to be discovered, and by its ultimate power for the uplifting of the world, physically, intellectually and morally. Scientific research for its own sake gives but a selfish joy, and may lead in the end to dry rot and to the scrap pile of human progress.

The progressive divergence of botanists and pathologists may well cause concern, but it has not yet become irremediable. The forces that make for dissociation can be overcome and closer union secured, but not by resolutions nor by legislation. There must be a general realization of the situation by both botanists and pathologists, followed by persistent effort at many points. I wish to suggest two important lines along which we should work.

In the first place, we should broaden our college courses in both botany and pathology. There has been extensive discussion in the English journals during the last few months on the botany to be taught after the war, and articles on the same subject are beginning to appear on this side of the water. It is urged that the teaching of botany should be broadened, that the elementary courses especially should not aim to instruct the student in botanical science, but rather to interest him in plants and in their manifold relations to his daily life. I shall not enter into this discussion except in so far as it concerns the subject before us.

I have listed the alma maters of 224 persons

actively engaged in pathological work, whose records were available. These persons are of various ages, are located in all parts of the United States, and the number is sufficiently large to be representative of the entire body of pathologists Of these 224 persons, 64, or 29 per cent., graduated at state agricultural colleges, 116, or 52 per cent., at universities which include colleges of agriculture, and 44, or 19 per cent., at colleges and universities without direct agricultural connections. I did not include in the above count those botanists who have been drafted into pathological service during the past few months on account of war conditions. These workers are of varied origin, are of all degrees of pathological training, and doubtless will largely resume their former positions with the return of normal educational conditions. Of the 44 pathologists listed as graduating at non-agricultural colleges and universities, over a third hail from a single institution, and a number of the remainder belong to the older group of pathologists who were trained as botanists, and entered the pathological field during the early period of its development. It appears then, that during the years preceding the war non-agricultural colleges and universities, excluding the single institution mentioned above, furnished less than 10 per cent. of the pathological workers of the United States. Is this a fair proportion? Why are so few graduates of our old-time colleges and universities entering the rapidly expanding field of plant pathology?

An examination of the curricula of these institutions is illuminating. Many of them offer no botany at all, or only elementary courses which are often labelled biology. Most of the institutions which possess departments of botany offer only standard courses in certain fundamental botanical topics and pay little if any attention to practical phases of the subject. Pathology as such is nearly, if not quite absent, and you can count on one hand with fingers to spare the institutions which give more than a passing consideration to mycology. Physiology, a subject of rapidly increasing importance to all branches of applied botany, fares only a little better than mycology. Botanical classes are usually small, graduate students few, and general interest in botany as a living subject undeveloped. The old botany of the schools and colleges is too narrow for the present day. Morphology and evolution are the backbone of most of these courses, and of nearly all text-books. But evolution needs no champion to-day, and botany taught from that standpoint alone does not appeal to American students. We need courses with a new method of attack, and text-books written from a new point of view. Botanical courses must be made more human. They must be squared with the progress and problems and life of to-day, even if this means radical revision of both methods and subject matter, and the surrender of some of the accepted standards which have served us indifferently well in the past. Fortunately there are all kinds of botanical subjects to interest all kinds of people, and with judicious selection elementary courses may be made to appeal to the many, rather than to the few. We must abandon the notion that the study of botany is a summum bonum, a choice privilege to be accorded only to the elect. The average student and the ordinary citizen must know botany, and must be aroused to an interest in plants as one of the most important elements of their environment. Only if this is done will the botany of the future achieve the importance it deserves. The responsibility for this vitalization rests largely on the undergraduate colleges. They must see to it that botany lives down its reputation of being an unimportant study for students who hope to become red-blooded men of affairs. They must not permit botany to be separated from the great field of agriculture which rightfully is hers. As well might chemistry withdraw from the industries, or mathematics deny mechanics and engineering. Botany has failed to qualify as an important subject during the emergency period of the war. Let us ask ourselves, is botany really unimportant to the nation at this time of emergency, or have botanists permitted it to appear so?

If now we turn to the curricula of the colleges of agriculture we find extensive courses

in pathology, in horticulture and in other branches of applied botany, but mycology, physiology and other fundamental botanical subjects too often receive inadequate attention. Specialization easily goes too far, and the product is a pathologist who is not also a botanist; he is a specialist with too narrow a training, with a foundation too restricted to permit the breadth of vision and the resourcefulness necessary for the adequate handling of many pathological problems.

Although these criticisms are not of universal application, I believe it is in general true that while the colleges on the one hand have been holding aloof and have not broadened their courses to include the modern applications of botany, the agricultural institutions on the other hand have specialized too strictly and have laid too little stress on the fundamentals of botany. Both tend to dwarf their students and practically restrict their graduates to their own fields, thus increasing the divergence between botanists and pathologists. In the future we shall need both botanists and pathologists. In addition, for the solution of many disease problems we shall need pathologists with a broad botanical foundation. These workers naturally should be trained by the colleges of agriculture. And we shall also need morphologists, physiologists, geneticists and ecologists with extensive knowledge of pathology, who naturally should be trained by the non-agricultural colleges and universities. When such a corps of workers is at hand, we shall not only have tremendously advanced both pathology and botany, but we shall have obliterated all distinction between the two subjects and made segregation into two groups of workers impossible.

A second vital force to draw together pathologists and botanists is cooperation in research work. The study of any plant disease is many sided, involving not only the study of the parasite and its effects upon and relation to the host, but the study of the host itself and of its varied relations to its environment, both in health and in disease. Not all pathologists are equipped to undertake certain of these problems which call for special training. Moreover, most pathologists, with manifold demands upon their time, are able to give attention only to the more immediately pressing features of the many problems before them. Hence their research work is perforce fragmentary and few diseases receive full consideration in all their phases. This procedure is faulty both from the scientific point of view, and in the end from the economic point of view as well, but it is made necessary by the pressure on the time of the pathologists and by restrictions on the use of public funds. The field of plant pathology is full of problems, morphological, cytological, physiological, ecological, genetical, which should receive attention, but whose solution is not in sight unless our botanical colleagues come to the rescue.

Many botanists in the colleges and universities could profitably take up this work. In choosing their research problems botanists have left the pathological field entirely to pathologists. In their desire not to encroach on the pathologists' domain they have avoided economic host plants to a large extent, and have turned away from cultivated fields and sought their material in woods and swamps. It is quite possible that by so doing they are sometimes passing by the material best suited to their purposes. Why should not geneticists breed economic plants more extensively and while determining the laws of inheritance, also produce improved strains of food plants? Why should not anatomists, cytologists, physiologists and ecologists study the potato or the cotton plant in health and in disease, and while conducting researches of fundamental scientific importance, be making needed contributions in the pathological field? Many of these pathological problems are suitable for master's and doctor's theses, and the fact that the problem has an economic flavor will, in the case of many students, give added zest to their work.

During the past year the pathologists, under the leadership of the War Emergency Board of the American Phytopathological Society, have inaugurated cooperation in research work to a degree which had been deemed impossible, so that the movement has attracted the attention of other scientific men. The pathologists

now propose to carry the get-together enthusiasm of the war over into peace times, to continue to foster the spirit of cooperation and to increase pathological efficiency by coordination of effort where such action is possible and desirable. It is clear that such a movement can not be forced, but must be allowed to grow under tactful management. The Society has therefore appointed an Advisory Board of six members to continue and foster the work initiated by the War Emergency Board. Can not the cooperative movement be extended to include other botanical workers? There are doubtless many botanists in the colleges and universities, especially those more or less isolated from botanical centers, who would gladly participate in cooperative projects. The problems are many, and there is no question but that pathologists will welcome most heartily the assistance of their botanical colleagues. It is probable that in many cases cooperation can be inaugurated most readily by conferences between individuals, especially on the part of workers in the same or adjacent regions, as the contiguity will ensure common interest in local problems, and will facilitate exchange of material and of ideas, and comparison of results. The Advisory Board will be glad to assist whenever possible by providing opportunities for cooperation and by facilitating the arrangements.

Botanists and pathologists are excellent complements of one another. In their closer union lies strength for the upbuilding of our common science in the momentous days which lie immediately before us. Of all the great nations of the earth we have suffered least from the ravages of the world war. We have felt its stimulus, but escaped its devastation. Hence the world is looking to America for leadership in many lines, and botany is one of these. We have the opportunity. We have the men. Have we the spirit? And can we supply the leadership? German domination is for the moment gone, but it will surely reassert itself if we are inactive. We must examine the bases on which German dominance in the field of botany has rested, and supply those factors which we now lack. We must write texts, compendiums and monographs to replace the German works which we are now using, and which we must continue to use indefinitely unless we ourselves write better ones. We must disseminate knowledge of botany amongst the people that we may receive the support which will enable compendiums to be written and research to be developed properly in both pure and applied fields. We must broaden our teaching of botanical subjects that we may produce not merely specialists, but the broad gauge men of wide perspective who shall be our leaders. We must stand together as botanists all, whatever our special field of endeavor may chance to be. If we do these things, and we can do them if we will, America will assume the commanding position in world botany.

G. R. LYMAN
U. S. DEPARTMENT OF AGRICULTURE

THE ELEMENTARY COURSE IN ZOOLOGY—IS IT SATISFACTORY?

AMONG the problems presented to the National Research Council by the government was one conveyed in the request of the War Department for the preparation of outlines of courses adapted to the conditions of the proposed Students' Army Training Corps. Like other divisions, that of biology undertook the work assigned it and formulated a suggested course. This was not printed and distributed in time to come into use, so that this effort of the council was entirely abortive. Since, however, biology was one of the subjects listed by the War Department's Committee on Education and Special Training, elementary biological courses of an intensive character were given in many institutions. It was the desire of several divisions of the council to determine the value of the educational experiment presented by the unusual requirements of the government's program. But unfortunately the conditions of the experiment were so disturbed by delays in starting work, by the occurrence of the influenza epidemic, and finally by demobilization of the corps before the completion of the first term, that no estimate could be placed upon the value of the results obtained from the operation of the novel

courses thus introduced. This is the general opinion of those to whom a hasty request for information went.

Along with this condemnation of the Students' Army Training Corps fiasco, there were, however, many expressions of opinion relating to the elementary courses in botany and zoology, among which were a number showing a lively interest in new or modified elements of the course. So pronounced was the interest in the character of the primary biological courses thus displayed that the division of biology decided to extend the inquiry further and so other letters were sent out as opportunity offered. Owing to the difficulty of reaching all those interested by letter, it has finally seemed best to make public through SCIENCE a request for expression of opinion regarding the nature of the elementary course in zoology or biology.

The connection of such an investigation into the nature of the elementary courses to research, the main concern of the National Research Council, may not be entirely obvious to all. That a relation of a somewhat intimate nature does exist seemed indicated to the division of biology when its executive committee undertook a general survey of the field in laying plans for a reorganization of its work for times of peace. Unless there be students trained in zoology there is little chance of developing new investigators in the subject, and in this training the elementary course occupies a peculiarly significant and important place. It offers the first contact between student and subject and has much to do with the formation of future tastes and habits. It forms, moreover, the chief connection between the zoology department and the college as a whole, and offers the greatest opportunity for exerting the proper influence upon the school. There sems also to be general agreement that this course is the most difficult to plan and to execute.

Because of these facts, and for the reason that the research council has the broadest interest in the relation of science to human welfare, it seems very properly one of its concerns to discover the kinds of elementary courses in science best adapted to serve as the first step in the preparation of scientific investigators and as the means for exerting the strongest and best influence upon the general college student.

Unless it be assumed that any kind of elementary course is satisfactory there must be some forms of it best adapted to meet the common needs of college students. That such is the feeling of many teachers is evidenced by the numerous attempts to formulate standardized beginning courses. Most of these have failed in their prime object because of emphasis upon nonessentials, although they have served a good purpose in stimulating discussion. The lesson seems to be written clear that if any large good is to be served by reopening this discussion there must be consideration of broad principles and an avoidance of unessential details. It seems a matter of no great moment whether the amoeba is studied at the beginning or at the end of the course, or at all. The amount of time devoted to any one type is not of great general concern but is a point which must be decided according to circumstances. To what extent, however, are the determining conditions of the course common to all institutions and how much allowance must be made for local conditions? Are there fundamental elements of a broad introduction to biology which necessitates the use of both plant and animal material or may the subject be presented adequately using either alone?

After satisfactory conclusions have been reached with regard to the general principles which should guide the construction of the introductory course, there are of course numerous practical questions which have a large bearing upon the success of its operation. How much time should be given it? Should the application of the student be consecutive or interrupted? How much of lecture, laboratory, conference and quiz work should there be? What use should be made of drawing and modelling? Should the work be given in the form of problems? How many forms of animals should be studied, etc.?

In order to arrive at any valid conclusions

regarding the problem raised by this investigation it would seem most appropriate to consider it in the light of any other scientific problem and to apply to its solution the scientific method. There should be no place for prejudice or for inertia. A rigid determination of the facts is called for, as a basis for conclusions. Such generalities as "the course should give a broad introduction to the subject" or "the course should give a look in on the subject" or "the course should cover the ground" do not contribute much to a reasonable practise. Only a clear analysis of the conditions inherent in the subject, of its interdependence upon other subjects in the curriculum, of the character of students to be taught, and of the instructor's part can lead to conclusions of value.

There are, accordingly, certain fundamentals which seem to demand attention. The first of those is the purpose for which the course is given. Is it primarily concerned in presenting the content, aims, methods or applications of the subject? Or is it possible in one course to include all these equally? Again, what form of presentation is the course to have—is absorption, verification or discovery on the part of the student to be emphasized? In considering the character of the course it would seem necessary also to have in mind the reason for its inclusion in the college curriculum as one of a series of more or less required subjects. Does it find a place here because of a certain informational value which recommends it to every liberally educated man, or is there something peculiar or distinctive about its methods or viewpoint which is absent, or less well represented, in other types of subjects?

It is true that no subject stands alone and that it is therefore impossible to make a complete and satisfactory determination of a course without taking into consideration, not only its interrelations within the curriculum, but also the varied material circumstances of the institution in which it is given. These considerations should not however prevent the fullest analysis of the problem or delay unduly the execution of such steps as are practicable for the improvement of the work. The influence of a thoroughly scientific practise in one department of a college can not fail to manifest itself to some degree in others and might lead to a much needed survey of the whole problem of college instruction. From the statements so far received it is apparent that there is lacking among biologists any general agreement upon the nature of the elementary biological courses and upon the reasons for their inclusion in the preparation of the liberally educated man. Such a situation would seem to be hardly commendable for any subject, and especially not for biology which deals with materials and processes in which purpose is so evident. It is possibly due to this lack of definite purpose and practise that biological subjects do not occupy the place in the curriculum which the best interests of the college students would require.

If there can be a full expression of opinion on these questions, after careful consideration, it may be possible to arrive at some general conclusion that should guide the operation of elementary biological courses. In this event it would then be possible to decide upon practical details with much less trouble, and with more profit. It is hoped that there will be such a general interest in this subject that a consensus of opinion upon at least the major elements of theory and practise may be reached. In order partly to guide such a consideration there will be published a number of typical outlines of courses already received upon which criticisms are invited. These suggestions and any other discussions upon the subject of zoological courses may be addressed to

C. E. McClung,
Chairman of the Zoology Committee, National Research Council
Washington, D. C.

WALLACE CLEMENT WARE SABINE[1]

Our colleague, Wallace Clement Ware Sabine, was born in Richwood, Ohio, June 13,

[1] Minute on the life and services of Professor Sabine placed upon the records of the Faculty of Arts and Sciences at the meeting of March 18, 1919.

1868. Four racial strains were joined in him, for each of his four names represents some family of his ancestors, one Scotch, one Dutch, one English, one French. The Sabines, of Huguenot stock, came to Ohio from New England in the early part of the nineteenth century. The Wares, his mother's family, of English Quaker antecedents, came there about the same time, probably from New Jersey. Of his father's father, John Fletcher Sabine, the son of a circuit preacher, we are told:

He was of such gentle disposition that in manhood he renounced the stern faith of his father and came to believe that "all men would be saved." . . . He died at the age of eighty-nine, with mind as vigorous and clear as in youth, with a remarkably retentive memory. His wife was Euphemia Clement, a gentle, industrious, reliable woman. Hylas Sabine was their oldest son.

Of his mother's father, Jacob Reed Ware, it is written:

He was one of the early, ardent abolitionists and lived on the most direct line from Southern slavery to freedom in Canada. . . . Untiring of body, alert of mind, and exceedingly strong of purpose he lived in perfect health, with such simple habits that at the age of ninety-eight, without disease, he fell asleep. J. R. Ware married Almira Wallace, a woman of force and uprightness. Anna Ware was their first daughter.

To those who knew Sabine well this brief family history is deeply significant. Gentleness, courtesy, rectitude, untiring energy, fixity of purpose that was like the polarity of a magnet, all these traits we found in him. It is interesting and impressive to see how the individualism and stern conscience that made his ancestors on the one side Protestants in France and on the other side Quakers in England found expression in him, under changed intellectual conditions. He was of the very stuff of which martyrs are made; in fact, he died a martyr to his sense of duty, but, with an austerity of morals and a capacity for devotion which none of his conspicuously religious forefathers could have surpassed, he held aloof, silently but absolutely, from all public profession of religious creed, and he took small part in religious observances.

As a child he was allowed to develop without forcing, but such was the natural vigor of his mind that he gained the degree of A.B. at Ohio State University at the age of eighteen. He is said not to have specialized in his college studies, but he had in Professor T. C. Mendenhall an inspiring teacher of physics, and his early interest in scientific matters is shown by the fact that he attended a meeting of the American Association for the Advancement of Science held in Philadelphia in 1884, when he was sixteen years old. On leaving Ohio State University in 1886 he came to Harvard as a graduate student in mathematics and physics, and he received the Harvard A.M. in 1888. From 1887 to 1889 he held a Morgan Fellowship, but in the latter year he became an assistant in physics. Rather early in his Harvard residence he was taken by Professor Trowbridge as partner in a photographic study of the oscillating electric discharge, and he showed a remarkable aptitude for work of this kind, requiring high experimental skill, yet he never became a candidate for the Ph.D. Absorption in the work of teaching prevented him for several years from engaging deeply in further work of research. He spent his energy and his talents in building up courses of laboratory work, designing and making apparatus for instruction and in every way practising with devotion the profession of a teacher. It is not too much to say that, for the fifteen years preceding his taking the duties of a deanship, he was the most effective member of the department of physics in giving inspiration and guidance to individual students of promise. This was due in part to his comparative youth, though none of the department were repellently old; in part to his sympathetic willingness to give help and to spend much time in giving help, though others were not lacking in this quality. It was perhaps due mainly to the fact that, while he was no more deeply versed than others in the profundities of physics and mathematics, he had a peculiarly clear vision for the right kind of experimental problem and for the best way of attacking it, and his students instinctively, it may be, perceived this.

For a long time he seemed to be content to remain in comparative obscurity, while directing others into paths of conspicuous achievement. He was made assistant professor of physics in 1895, after six years of teaching, in which he had published little or nothing descriptive of research. This was partly because he had a most severe standard for what a research paper should be: it should describe some piece of work so well done that no one would ever have to investigate this particular matter again. To this standard he held true, with the result that his published papers were remarkably few and remarkably significant.

One might have expected him, when he found time for research, to take up some problem in light, for that seemed to be his chief field of interest; but accident, and a sense of duty, turned him to a different quarter. The Fogg Art Museum, on its completion in 1897, proved to have an auditorium that was monumental in its acoustic badness, and President Eliot, who had formed a high opinion of Sabine's qualities, called upon him to find a remedy, as a practical service to the university. With this warrant for diverting some of his energy from teaching, Sabine entered upon an investigation which proved to be his most conspicuous scientific work. Though he was dealing with a new structure, he was attacking a practical problem as old as the institution of public buildings. It had never been solved before in any thorough-going manner. He did solve it, and he did this not by virtue of any extraordinary resources given by modern science. He did it in such a way as to show that it might have been done by a man like him centuries before. Not only did he cure the defect of the particular room that first engaged his attention; he went on with his study till he could tell in advance what the acoustic qualities of a projected auditorium would be; and his visible instruments in all this achievement were organ pipes, common fabrics and materials, and the unaided human ear.

Was it, then so easy and simple a thing to do? Did he merely happen to find the solution of a difficulty thousands of years old? No. He succeeded by reason of a combination of qualities, among which were unending patience and untiring energy. He must work in the small hours of the night, when other men had ceased from their noisy labors and when street-cars were infrequent; he must, for certain ends, work only in the summer, when windows could be kept open; in the early summer, before the crickets began their nightly din. He must work with the most scrupulous regard for conditions that to another might seem trivial. He once threw away the observations of months because he had failed to record the clothes he wore while at his work. Such was the difficulty of his undertaking, on the mere physical side, and such the rigor of his devotion to it. We say of such a man, It is a pity he died so young. If he had taken care of himself, had been regular in his meals and in his hours of sleep, he would have had a long as well as a useful life. Yes; but the things he undertook to do, and did do, can not be done by a man who must be regular at his meals and regular in his hours of sleep.

The establishment of a Graduate School of Applied Science, in place of the undergraduate Lawrence Scientific School which had existed at Harvard for a long time, was the result of a movement led by Sabine in 1906. It was doubtless his hope, from the start of his connection with this revolutionary action, to make the Harvard School of Applied Science one of the highest and best in the world; but concerning the wisdom of making it distinctively and only a graduate school, he was not altogether positive, in spite of the fact that the suggestion to make it such is attributed to him. In fact, the decision of the faculty to approve this policy was arrived at in a curiously casual way. Argument against it was made at a faculty meeting, and nobody seemed to be confidently in favor of it. Sabine told a colleague the next day that just before the vote was taken he tried to get the president's attention, to move a postponement of the question. He did not succeed, the vote was taken, and the policy was launched.

Sabine took the deanship of the Scientific School reluctantly, at the urgent request of

President Eliot, but he threw himself into the duties of the office with characteristic energy, devotion, and elevation of ideals. It was his ambition to make the school as good as any school of applied science anywhere, and he strove for that end.

Whether the history and fate of the school would have been notably different if it had included undergraduate programs of study, is, fortunately, a question we need not discuss. For it is now possible to undertake the experiment of building up at Harvard a school of applied science second to none in its higher reaches but standing on a base of directed undergraduate work done within Harvard walls. In this undertaking we can have no better ideals than those which Sabine's deanship kept always before us.

When this deanship ended, he returned gladly to the work of teaching and research. and but for the war he would probably have had before him a long career of growing usefulness and fame, and would have lived to a vigorous old age according to the habit of his ancestors. But from that fiery furnace into which other men were drawn by millions he could not hold himself back. He would have felt recreant if he had escaped unscathed. Going to France in 1916 with the intention of giving a course of lectures as exchange professor at the Sorbonne in the fall, he engaged during the summer in the work of conducting tuberculous patients from the French hospitals to Switzerland, an enterprise undertaken by the Rockefeller Foundation. Overworking in this, he was attacked during the fall by a disease which nearly ended his life and compelled the postponement of his Sorbonne lectures. When he was able to be moved, he went back to Switzerland, this time as a patient; but he gained strength studying French constantly meanwhile, and in the spring of 1917 gave his lectures, on achitectural acoustics, in Paris. These ended, he went through some months of extreme activity in the technical science service of the allied governments. Returning to America in the late fall, he went on with similar work in Washington, and elsewhere, coming to Cambridge for his lectures every week, eating and sleeping when and where he could, always too busy for the surgical operation which his physical condition demanded. He refused military rank, declaring, with that severity of judgment which sometimes verged upon intolerance, that the uniform should be worn only by those who were subject to the dangers and labors of the front. But he risked his life constantly, and at last fatally, in the service of the country and the university.

We have known in him a rare spirit, and we reverence his memory.

Edwin H. Hall,
C. N. Greenough,
P. W. Bridgeman,
Committee

SCIENTIFIC EVENTS

THE GASPÉ BIRD RESERVES

The Parliament of the Province of Quebec, in its present session, has passed a law creating, on very broad lines, the remaining lodges of water-fowl on the shores and the islands of the Gulf of St. Lawrence into one great Bird Reserve to be under the administrative control of the Minister of Fisheries. Three definite areas are embraced within this protective provision, all of which are within the county of Gaspé.

1. Percé Rock, the picturesque and brilliant Devonian Island which lies a few rods off the coast of Percé village. Its bird colony is constituted of the Herring Gull and the Crested Cormorant.

2. The east and north cliffs of Bonaventure Island which lies three miles out from Percé. Here is probably the largest surviving colony of the Gannet with its customary associates—the Kittiwake, Razor-billed Auk, Puffin, Guillemot and Murre. The law takes over the entire face of the high cliffs where the two colonies on this Island are located and also a belt of land ten feet back from the edge of the cliffs.

3. The celebrated but now somewhat depleted colony of the Bird Rock, northernmost of the Magdalen Islands, 124 miles out to sea from Percé, in the heart of the Gulf.

The provisions of the law are rigorous. No one shall take or molest the birds, nests or eggs, nor carry a gun or other hunting gear within a mile of the sites indicated, either by land or water, under severe penalty of fine or imprisonment; and if a boat is used in violation of this law it is liable to confiscation. The law is made so broad as to include all migratory game, non-game and insectivorous birds as specified under the international treaty for the protection of such birds.

The extraordinary character of this law now in force is that it affords protection to a class of water-fowl which are commonly regarded as having little to do with the economic interests of mankind, and it specifically takes cognizance of the fact that these creatures are entitled to protection because of their natural beauty, their scientific interest and the part that they play in the scheme of nature. There could be no better indication of the liberal and high-minded sentiment of the Province of Quebec than this enactment which was initiated in the Parliament by the Honorable Honoré Mercier, Minister of Fisheries, in response to the labors and urgent representations of those who have had the interests of these colonies at heart. The Province of Quebec has thus created one of the largest bird reserves in the western continent and has erected a monument which is greatly to the credit of its own high-minded sentiment.

JOHN M. CLARKE

REORGANIZATION OF FARM MANAGEMENT OFFICE

REORGANIZATION and expansion of the Office of Farm Management of the United States Department of Agriculture is recommended by the committee of farm management leaders and others appointed some time ago by Secretary Houston to study the work of farm management and outline projects for more extensive studies.

The committee is made up of the following economists and students of farm crops: H. C. Taylor, agricultural economics, University of Wisconsin; George F. Warren, farm management, Cornell University; Andrew Boss, agronomy and farm management, University of Minnesota; J. A. Foord, agriculture and farm management, Massachusetts Agricultural College; J. I. Falconer, rural economics, Ohio State University; R. L. Adams, farm management, University of California; G. I. Christie, assistant Secretary of Agriculture, and representatives of the Bureau of Crop Estimates, the Bureau of Markets and the Office of Farm Management of the Department of Agriculture.

The basic recommendation of the committee is that the office be expanded to include both farm management and farm economics and that it be established as a bureau under the name of Bureau of Farm Management and Farm Economics. This, the committee states, it recommends "in recognition of the work already accomplished in farm economics along with the investigational work in farm management and in view of the great need for still further studies of the farming business."

Practically all of the changes recommended are in the nature of expansion and improvement rather than of creation. The system recommended for studies in cost of production is much more comprehensive than that heretofore used. "We have reviewed the projects now under way," the committee says, "and wish to commend their continuance and development." Some projects, it is thought, should be continued under other names. Some that are related to agronomy and some to other subjects, says the committee, "should perhaps be transferred to some other bureau of the department, securing the information or data desired on these lines through cooperative relations rather than independent action." In the projects underway, a great deal of work has been found that, the committee thinks, could be more profitably included under the term "Farm economics."

The work of the bureau, in the opinion of the committee, should be grouped around the following projects: Cost of production, including financial records, enterprise records, complete cost records, price relations and basic unit factors; farm organization, including farm business analysis, farm practise, effective

use of labor and farm equipment; farm finance, including methods of financing, insurance and taxation; farm labor, including supply and movement, trend of population, living and housing problems, creating new productive enterprises for farm labor and standards of supervision and compensation for farm labor; agricultural history and geography, including trend of agricultural development, shifts of agricultural production, relation of American to foreign agriculture and supervision of the Atlas of Agriculture; land utilization, including land resources and utilization, land settlement and land ownership and tenancy; farm life studies, including cooperation and trend of cooperative movements as affecting the farmer's life and activities on the farm, agricultural relations to other industries, agriculture for industrial workers, conditions of farm life as affecting national welfare; extension work, including publications and illustrative material, farm management demonstrations, farm labor supply and other farm economics demonstrations.

CORPORATION CHEMISTRY

The Newark Technical School has been elevated to the rank of a collegiate institution and the recently appointed director, D. R. Hodgdon, has made plans for special courses in theoretical and industrial chemistry. This has been recognized as a very desirable step because of the predominance of chemical corporations and chemical industry in the state of New Jersey.

The director announces that Frederic Dannerth, has consented to deliver a course of thirty lectures on corporation chemistry during the coming college year. Dr. Dannerth is well known as advisory chemist to many of the leading corporations in the country. He was one of the first to conceive the idea of a system of laboratory management, and is the inventor of numerous processes for industrial works using rubber, resins, oils and plastics.

This new course is probably the first of its kind offered to students of chemistry in America and is a direct outcome of the chemical development in the country during the past five years. The aim will be to show the application of the principles of industrial chemistry to the problems of manufacturing corporations—both those which are now in operation and those which are contemplated by investors and banking corporations. The lectures and seminars will be conducted in such a manner as to be intelligible to heads of the departments for purchasing, manufacturing and selling, as well as by fourth-year men in chemistry. The course will cover: (1) a study of industrial surveys conducted by chemists for the purpose of developing sources of supply for raw materials (this includes animal, plant and mineral materials). (2) Surveys of the executive departments of purchasing, manufacturing and selling. (3) Surveys of the advisory departments of engineering, law and research. (4) Laboratory Management (design, equipment, organization and administration). (5) The Economic Office (organization of the information files, museum of materials and products, as well as the library). The purpose of the course is to prepare graduates in chemistry for the hard, practical problems which confront them when they take up industrial work and at the same time an opportunity will be afforded persons now in executive positions to study the translation of scientific knowledge into industrial development.

MEMORIAL PROFESSORSHIP TO DR. JAMES JACKSON PUTNAM, 1846–1918

It is hoped that there may be an endowment of the professorship of diseases of the nervous system in the Harvard Medical School in memory of Dr. James Jackson Putnam.

In the development of this increasingly important branch of medicine, Dr. Putnam was a pioneer in Boston and in the country at large, while he was widely recognized in Europe as a neurologist of distinction. He inaugurated the neurological clinic at the Massachusetts General Hospital in 1872, and through forty years of service was devoted to its interests, and to teaching in the Harvard Medical School. In 1893 he was appointed the first professor of diseases of the nervous system; the professorship was then, and has remained, without endowment.

It is believed that those who have known Dr. Putnam may like to join in endowing this professorship which should always bear his name, and which would fulfill his hope that neurological work of a high order might be developed at the Harvard Medical School. To all of us who knew Dr. Putnam it would also commemorate the devotion and the self-sacrificing work of his lifetime.

President Lowell sends the following letter:

Harvard University, Cambridge,
February 8, 1919

My dear Dr. Walcott,

The suggestion of founding a professorship of diseases of the nervous system in memory of Dr. James Jackson Putnam appeals to me deeply both on account of the value of such a professorship to the medical school, and on account of the deep affection I had for Dr. Putnam and of my reverent esteem for his character. The foundation ought to appeal strongly to all who recognize the ever-increasing suffering caused to our over-sensitized community by nervous ailments, and to all who knew Dr. Putnam as patient or as friend.

Very truly yours,
A. Lawrence Lowell

It is hoped that $50,000 may be raised as endowment, of which more than half is already promised. A reply from any one who proposes to contribute is requested now, but payment, either by check or in Liberty Bonds, may be made any time before December 31, 1919.

H. P. Walcott,
Charles C. Jackson,
Edward W. Emerson,
Edward H. Bradford,
Moorefield Storey, *Treasurer*
735 Exchange Building, Boston

SCIENTIFIC NOTES AND NEWS

Sir William Crookes, the distinguished English chemist, died on April 4, in his eighty-seventh year.

Dr. S. F. Harmer, keeper of the department of zoology since 1907, has been appointed to succeed Sir Lazarus Fletcher as director of the British Natural History Museum, South Kensington.

At a meeting of the Société de Biologie held in Paris on January 25, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, New York, was elected an associate member of that society.

The Royal Geographical Society has awarded the Founder's Medal to Colonel E. M. Jack for his geographical work on the Western Front; the Patron's Medal to Professor W. M. Davis, of Harvard University, for his eminence in the development of physical geography; the Victoria Medal is awarded to Professor J. W. Gregory for his many and important contributions to geographical science; the Murchison grant to Dr. W. M. Strong, of the North-eastern District, Papua, for his journeys and surveys in New Guinea; the Cuthbert Peek grant to Professor Rudmose Brown for his geographical work in the Antarctic and in Spitsbergen; the Back grant to the Venerable Archdeacon Stuck, of Fort Yukon, for his travels in Alaska and ascent of Mount McKinley, and the Gill memorial to Mr. W. J. Harding King for his investigations of desert conditions in northern Africa.

The Schwabacher prize of 20,000 marks was recently divided between Professors Rubner and Zuntz, both of Berlin, for their work on diet in war time.

Dr. H. S. Washington, of the geophysical laboratory, Carnegie Institution, has been elected a foreign member of the Accademia dei Lincei.

Professor J. C. Merriam, of the University of California, has returned to Washington to act as chairman of the National Research Council.

Dr. Hermann M. Biggs, state commissioner of health of New York, has been granted six weeks leave of absence and is now *en route* to France, where he will aid in the establishment of an international Red Cross society.

Dr. T. Wayland Vaughan, accompanied by D. D. Condit, C. W. Cooke and C. P. Ross, have gone to the Dominican Republic, to make a preliminary inspection of the geology in preparation for a geological survey under the direction of the military government of the

republic. Lieutenant Colonel Glenn S. Smith is organizing a topographical survey.

C. K. Leith, professor of geology at the University of Wisconsin, has returned from Paris, where he served as mineral adviser in the economic section of the American Peace Commission. Prior to the Paris work, Professor Leith took an active part in mineral advisory work for the Shipping, War Industries and War Trade Boards, in Washington, particularly in relation to restrictions and regulation of international trade. Professor Leith has now left government service to resume his work at Madison.

Major Wm. Lloyd Evans, C.W.S., who was the head of the laboratory and infection division, Edgewood Arsenal, has resumed his duties with the department of chemistry of the Ohio State University, having been discharged from the U. S. Army. On March 6 Major Evans gave a public lecture under the auspices of the Ohio State University Chapter of Sigma Xi on "America's answer to German gas warfare."

Captain Paul Popenoe, San. C., director of the section on vice and liquor control, Commission on Training Camp Activities, was discharged from military service on April 2. Mr. Popenoe, who was formerly editor of the *Journal of Heredity,* is organizing a department of law enforcement for the American Social Hygiene Association, New York City.

Mr. Robert L. Moore, of the Bureau of Standards, has been transferred to the rubber laboratory of the bureau at the University of Akron, Akron, Ohio.

Dr. Albert M. Reese, professor of zoology in West Virginia University, will leave the last of April for British Guiana, where he will spend the summer at the Tropical Research Laboratory of the New York Zoological Society. During his absence the work of the department will be in charge of Dr. Harrison H. Hunt, assistant professor of zoology.

Mr. W. M. Smart, of Trinity College, has been appointed chief assistant at the observatory of the University of Cambridge.

Dr. T. A. Henry, late superintendent of the laboratories at the Imperial Institute, London, has been appointed director of the Wellcome Chemical Research Laboratories, London. Dr. F. L. Pyman, the former director of these laboratories, has accepted the professorship of technological chemistry in the Manchester Municipal College of Technology, and in the University of Manchester.

Dr. Addison, president of the British local government board, has appointed Miss Janet Mary Campbell, M.D., M.S., to be a medical officer of the board in special charge of the work of the board in respect of maternity and child welfare.

Mr. J. O. Lewis, superintendent of the petroleum experiment station at Bartlesville, Oklahoma, has been appointed chief petroleum technologist of the Bureau of Mines, to succeed Mr. Chester Naramore, who has resigned from the bureau to join the Union Petroleum Company, at Philadelphia, Pa.

The United States Interdepartmental Social Hygiene Board announces the following appropriations from the Scientific Research Fund of the board: Leland Stanford Junior University Medical School: (1) Investigation into more effective treatment in acute and chronic gonorrhea, under the direction of Dr. R. L. Rigdon, clinical professor of genitourinary surgery, and Dr. Alfred B. Spalding, professor of obstetrics and gynecology, San Francisco, $2,300. (2) The permeability of the meninges to antisyphilitic drugs—an attempt to increase their permeability, under the direction of Dr. Henry G. Mehrtens, clinical professor of neurology, San Francisco, $2,300. (3) Investigation into more effective methods of treating syphilis, under the direction of Dr. Harry E. Alderson, clinical professor of dermatology, $2,600; total, $7,200. University of Michigan, College of Medicine and Surgery: (1) A research for an improved method of demonstrating *Spirochæta pallida* in human tissues, under the direction of Dr. Alfred S. Warthin, professor of pathology, Ann Arbor, $6,000.

Dr. Aleš Hrdlička will deliver during the months of April and May a series of four lectures at the medical college of the Georgetown University, on "The relations of anthropology to medicine."

The reconstruction lectures given Saturday evenings at Yale University last term during January, February and March were resumed on April 5 and will continue through May 17. The complete schedule of the remaining lectures is as follows:

April 5. Dean Charles R. Brown, "Reconstruction and the churches."

April 12. Professor Lester P. Breckenridge, "Reconstruction and engineering."

April 19. Dean George Blumer, "Reconstruction and the medical profession."

April 26. Professor C.-E. A. Winslow, "Reconstruction and public health."

May 3. Director Russell H. Chittenden, "Reconstruction and science."

May 10. Dean Thomas W. Swan, "Reconstruction and the legal profession."

May 17. Professor Irving Fisher, "Reconstruction and the price level."

The Cutter lectures on preventive medicine given annually under the terms of a bequest from John Clarence Cutter, were given at the Harvard Medical School on March 17 by Harry E. Mock, M.D., Lientenant Colonel, M.C., U.S.A., Division of Reconstruction of Disabled Soldiers War Department, Washington, D. C., on "Industrial medicine considered from an economic viewpoint," followed by "Reclaiming the disabled," illustrated by motion pictures, and on April 2, 3 and 4 by Alice Hamilton, M.D., special investigator of the U. S. Department of Labor, Chicago, Illinois, on "Industrial poisoning in the United States." The subjects of the three lectures were: (1) "Lead"; (2) "Other organic poisons"; (3) "Poisons of the aromatic series and of the fatty series."

UNIVERSITY AND EDUCATIONAL NEWS

An alumni memorial to honor Dr. C. R. Van Hise, late president of the University of Wisconsin, has been proposed in the form of a Van Hise Memorial Geological Building to be erected on the campus to bring together under one roof the departments of geology and mining engineering, as well as the state and national geological surveys.

Two gifts to the Harvard Medical School have been received recently. One is an anonymous donation of $50,000 for the establishment of the James C. Melvin Fund for Tropical Medicine. The income is to be used for research in preventive medicine. The other is the residuary bequest of Horace Fletcher, who established a wide popular reputation as a dietitian. The income is to be used to "foster knowledge of healthful nutrition."

Scovill Park, embracing several acres of land lying next to the property of the University of Kentucky in Lexington, Kentucky, has been donated to the university by the city. The land is given without condition except that it be made available to the city for playground purposes until the university is ready to build on it.

Professor Carlton I. Lambert, F.R.A.S., an old scholar of the City of London School, has given £1,000 with which to found a scholarship for applied science at the school.

New York University and Bellevue Hospital Medical College will admit women on the same basis as men and with full privileges of the college, in September.

Dr. Horace D. Arnold has resigned as director of the graduate school of medicine of Harvard University.

Dr. Victor Ziegler, professor of geology and mineralogy and head of the department at the Colorado School of Mines, has resigned this position.

Dr. C. C. Forsaith, who has been instructor in the department of wood technology at the New York State College of Forestry, at Syracuse University, for the past year and a half, has been appointed assistant professor of wood technology in the same institution.

Dr. George Barger has been appointed to the chair of chemistry in connection with medicine at Edinburgh University. Dr. Barger is at present research chemist to the Medical Research Committee, National Health Insurance.

At the University of Cambridge Mr. Joseph Barcoft, F.R.S., of King's College, has been appointed reader in physiology; Mr. A. V. Hill, F.R.S., of King's College, university lecturer in physiology, and Dr. Hartridge, of Kings College, university lecturer in the physiology of the senses.

DISCUSSION AND CORRESPONDENCE

PATENT REFORM PROSPECTS

A *Report of the Patent Committee* of the National Research Council, recommending *inter alia,* (1) the separation of the Patent Office from the Department of the Interior, (2) the creation of a single Court of Patent Appeals, to be located in Washington, and (3) certain salary readjustments, is being printed in the March issue of the *Journal of the Patent Office Society*—of which additional contents are as follows: "The Patent Office from 1828 to 1836" (a historical article), by W. J. Wyman; "A United States Patent Commission" (preferring a commission to a commissioner), by John Boyle; "A Proposed Reorganization of the Examining Corps" (advocating the grouping of related divisions into "departments," to be supervised by the respective members of a strengthened board), by Bert Russell; "Art Classification of Patents for Patent Office Use" (favoring reliance on analogies of structure and function), by G. A. Lovett.

It is understood that the matters referred to in the above-mentioned report are but initial measures and that the Patent Committee has been continued, to press for necessary legislation.

At a meeting of the Patent Office Society on February 17, the following resolution was taken with reference to the proposed separation: That the Patent Office Society approve, and support by all proper means, both as an organization and as individuals, that National Research Council bill which provides for the establishment of the Patent Office as a separate institution, independent of the Interior Department and of every other existing department of the government. The discussion of the foregoing resolution included no single word of disesteem toward Secretary Lane, under whose jurisdiction the office now is.

Dr. Geo. E. Hale, chairman of the Council, in an address to the Patent Office Society on March 3, 1919, stated the present personnel of the council's enlarged Advisory Committee on Industrial Research, including many well-known leaders in the industrial world. Dr. Hale deprecated the impracticable distinction between "pure" and "applied" science, and emphasized again, even in connection with industrial advance, the importance of what he preferred to call the fundamental sciences.

Because Dr. Hale had also stressed the importance of those cross connections for which the Research Council aims to provide, associating the various groups of specialists now at work in diversified and somewhat isolated fields, and because of the prospect of a continued activity on the part of the Patent Committee as above referred to, this latest announcement was construed by Dr. Hale's hearers as justifying the hope of some very real and general cooperative effort toward the establishment of a patent system that shall in fact do its proper part—nationally and perhaps internationally—"to promote the progress of science and the useful arts."

Bert Russell

A STANDARD SCIENTIFIC ALPHABET

To the Editor of Science: May I call the attention of Mr. J. C. Ruppenthal whose letter on, "A Standard Scientific Alphabet" appeared in Science for February 21, 1919, pp. 191–192, to the International Phonetic Association.

Its secretary, just before the war, was Paul Passy, its address, 20 rue de la Madeleine, Bourg La-Reine, Seine, France; its organ, *Le Maître Phonétique.* It had about 1,800 members and it has adopted an International alphabet which can be used for all languages

and is widely employed by phoneticians. The work of Mr. A. G. Bell and the late Mr. H. Sweet should also be referred to in this connection.

Of perhaps greater importance than a standard alphabet is the question of an international language. In this connection the "Academia pro Interlingua" has carried on a scientific study of the question and perhaps the majority of its members are in favor of adopting simplified Latin. Professor G. Peano, of the Turin (Italy) University, is president of the Academia which has been in existence over twenty-five years.

A. FANTI

BUREAU OF STANDARDS

DR. MOODIE'S OPISTHOTONUS

TO THE EDITOR OF SCIENCE: Professor Moodie's Study No. 3, Paleopathology, "*Opisthotonus* and Allied Phenomena among Fossil Vertebrates,"[1] aims to show that the bent back head which one sees not commonly in well preserved vertebrates is "a manifestation of spastic distress" of the creature, "suggesting a strong neurotoxic condition," and leading the author even to seek for the infecting bacteria which have given the shortly-to-be-fossilized vertebrate a cramp in the neck. This condition Dr. Moodie compares with opisthotonus in man as illustrated in Bell's painful drawing.

I wonder, nevertheless, whether it is necessary to seek so far afield for the cause of this head-bent-back position in fossils. This position, every one will admit, is an extremely common one, in fact most backboned animals show it when they are well preserved—while opisthotonus is, so far as I know, an extremely rare malady. It would trouble one to find recorded cases of it in reptiles or birds, amphibia or fishes: even in mammals collectively the percentage of deaths following opisthotonus would evidently be microscopically small. Then, too, when one of these rare cases died in cramp would it be apt long to retain that position while it floated down a stream with muscles rotting, or while it dried out of its soddenness on a bank of mud, or while deliquescently putrid it became picked more or less to pieces by all manner of sarcophagous creatures? No it seems to me that what the doctor calls "opisthotonus" is merely a physical phenomenon which causes the neck region of a macerating vertebral column to bend backward. For on the back of the column are stouter ligaments which hold the bones together: hence when the backbone eventually loosens up in the process of decomposition the bodies of the vertebræ separate earlier than the arches, thus producing the inbent column. Of course there would be no great degree of bending back in the chest region, for here the cage of ribs would long keep the back straight: nor in the lumbar region, since here the neural arches are short and there is therefore less leverage for their dorsal ligaments: nor again in the tail, for here the ligaments are far more nearly balanced in all sides of the column.

BASHFORD DEAN

COLUMBIA UNIVERSITY

[1] *Am. Naturalist*, LII., pp. 369–394.

FIELD WORK IN ARIZONA

TO THE EDITOR OF SCIENCE: At the last faculty meeting of the University of Arizona, President R. B. von Kleinsmid outlined a plan for summer-session work that was received with enthusiasm by the faculty, and may be of interest to many readers of SCIENCE. Since the climate of Tucson is not suited to the conventional campus summer-session, the university plans to carry on vacation-work in the field, in several parts of the state where the climate is more bracing or where the work would be of such a character as to make the mid-summer heat a negligible consideration. It is proposed that groups of students under the direction and leadership of professors from the University of Arizona, study: archeology through actual excavation work in the northern part of the state, geology at the Grand Canyon, biology at the Mt. Lemon camp, mining engineering at the great copper mines, etc. Such opportunities for first-hand observation and investigation in an interesting and comparatively fresh field will doubtless appeal

to many teachers of science throughout the country.
F. M. Perry

Tucson, Arizona

QUOTATIONS

SCIENCE IN THE BRITISH PARLIAMENT

Among the 707 members of the new parliament there are two fellows of the Royal Society, that is to say, of the body which contains the leading representatives of scientific knowledge and research. One of these, Mr. Balfour, must be taken as an example of the smaller number of fellows who are elected because of their social position and general culture rather than of the normal body of fellows elected because of their devotion to and distinction in scientific research. Sir Joseph Larmor, the other fellow, is a typical example of high scientific distinction, and it is merely an individual accident that his parliamentary record is one of blameless devotion to party politics rather than of specific representation of science. Curiously enough, there are two former teachers of human anatomy—Dr. Addison and Sir Auckland Geddes—and Mr. Mackinder was a well-known geographer before he became a politician. The great experience of Sir Philip Magnus has been in the directorate of institutions for applied science and technology rather than in actual scientific pursuits, and a similar comment may be made on Mr. Woolcock's relation to pharmacology and drugs.

The new parliament will be charged with the duty of reconstructing the social, commercial and industrial fabric of the country and of the empire, and among its 707 members there is only one whose life has been devoted to scientific research. Let it be said at once that the object of calling attention to this defect in the House of Commons is not to advocate the presence in parliament of scientific representatives who should try to protect the interests of scientific men in the fashion in which the representatives of professional and working-class trade unions foster the material interests of their members. The point which ought to be taken is wider, and concerns not a group of individuals, but the whole nation. Huxley, in an address delivered to workingmen in 1868, stated the case in words of enduring cogency. After saying that any one would be a fool who should sit down to a game of chess on the winning or losing of which depended his life and fortune without knowing something of the rules of the game, he went on to say:

> Yet it is a very plain and elementary truth, that the life, the fortune and the happiness of every one of us do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of two players in a game of his or her own. The chessboard is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. The player on the other side is hidden from us. We know that his play is always fair, just and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength, and one who plays ill is checkmated—without haste, but without remorse.

In the complicated conditions of modern life, very few of us can play our own game. In sanitation, housing, public health, provision for research, relation of general research to specific inquiries, and a multitude of other matters of fundamental importance, we have to leave all the important moves to parliament. Neither in parliament nor in the departments from which most of the initiation comes, and on which all the execution will depend, is there a sufficient leaven of the requisite knowledge.

It will be said that expert advice is always taken on scientific matters. Assuming this, and adding to it the further assumption that the advice is always acted on with intelligence and sympathy, it is to be noted that expert advice is also always taken on financial matters, commercial matters, legal matters and so forth, and that, none the less, there are in the House of Commons very many members with expert knowledge of, and interest in, finance business, and law. These are ready and able to suggest the final criticisms, adjustments and coordinations that may be required in the measures

that are proposed. There is not this opportunity in science, although science is fundamental.

The relative absence of scientific men from the House of Commons is both a cause and a symptom of the neglect of science in this country. The majority of members of parliament fall into two classes. One of these consists chiefly of representatives of the great working-class organizations, whose subscriptions supply the necessary funds for contesting elections, and whose membership gives the requisite electoral backing. Even if a similar combination were to be desired in the case of scientific workers—an extremely doubtful proposition—their numbers are too few to make it effective. The other great class consists chiefly of persons who have inherited or acquired a competence, and who have the money and the leisure to woo an electorate. As matters are arranged at present, it is almost impossible for a man who devotes his life to scientific research to acquire a competence. His life is spent between the laboratory and the lecture-room amid gray suburban or provincial surroundings, with possibly a small retiring pension. He must be content, and for the most part he is content, with the high adventures of thought and with the appreciation of his fellows. We suggest that this compulsory segregation is bad for scientific researchers and worse for the nation.—*London Times.*

SCIENTIFIC BOOKS

Contributions to Embryology. Published by the Carnegie Institution of Washington. No. 1, 1915; No. 26, 1918. Volumes 1–8.

Every Amercan embryologist who does not indulge in envy may pardonably take pride in the *Contributions to Embryology* issued by the Carnegie Institution. They form an anatomical publication of unqualified distinction, since all three factors needed for success have fortunately been realized. First, there has been a group of able contributors with beautifully illustrated and important manuscripts; further, there has been generous means for the proper publication of whatever is accepted. Finally, there has been an editor in charge, whose name does not appear in the title, but whose impress is upon every page. It is not by chance that the great journals of anatomy have been edited by no less distinguished leaders than Max Schultze, His and Virchow. The Carnegie Contributions which thus far rank so well with these are essentially *Mall's Archiv* and one of his worthiest memorials. Even though they are being so ably continued by his junior colleague in the Carnegie Laboratory, who may realize all that Mall had planned, we can not repress deep regret that the work was only well established—scarcely more than begun—when it was left for others to carry on.

Why is the publication so attractive? Possibly because of the absence of "efficiency" methods, so incompatible with scholarly and artistic work. The contributions even appear at irregular intervals when something of moment has been completed and not because it is time for a new issue. There are no rules for preparing standard manuscript, no Procrustean regulation that for every plate there must be so many pages of text, and thanks to the Carnegie Institution, no insulting request that authors of accepted articles pay any part of the cost of publication. If the editor finds a contribution unworthy of a place, he may decline it; but if accepted, it will be fittingly published with the needed figures skilfully and delicately reproduced. And because the editor's judgment is sound, it becomes an achievement to have an article appear in such select company. Probably the *Contributions* shed their enlightening rays in the far corners of the earth, but it is not so announced. The contributor, however, knows for himself that wherever human embryology is studied, these publications will be sought for and treasured.

The series of twenty-six papers thus far published begins auspiciously with Mall's monograph on the fate of the embryo in tubal pregnancy, and Professor Mall has contributed two others—on cyclopia and on the intrachorionic magma. Professors Van der Stricht and Duesberg, who, during the occupation of Belgium, became the welcome guests of Amercan anatomists, continued here their well-

known investigations. Van der Stricht has written on the genesis and structure of the membrana tectoria and crista spiralis of the cochlea, and Duesberg on "la fécondation des ascidiens"—a study of chondriosomes. Cowdry likewise has dealt with the mitochondrial constituents of protoplasm and has supplied a shorter paper on the chromophile cells of the nervous system. Mitochondria in nerve cells are quantitatively considered by Madge D. Thurlow. The transitory cavities in the corpus striatum are described by Essick. Two papers deal with tissue cultures, the occurrence of binucleate cells being described by Macklin, and the development of connective tissue fibers by Margaret R. Lewis. Miss Sabin, through series of fine injections, strikingly reproduced, has traced the transformation of the posterior cardinal veins of pig embryos, and, in a second paper, the origin of the primitive vessels in the chick. Streeter has advanced the study of the cerebral sinuses, which have been beautifully drawn, and has described also the formation and spread of the periotic tissue spaces. Weed's important work on the development of the cerebrospinal spaces forms the whole of Volume 5. Clark interprets an extraordinary anomaly of the thoracic duct, and Cunningham describes the pulmonary lymphatic vessels of pig embryos. There are three monographic studies of normal human embryos, by Ingalls, Johnson and Watt; and a specimen with spina bifida is described by Miss Wheeler. Corner reports on the corpus luteum in the pig. Meyer has a statistical study of prenatal growth, based on obstetrical records, and Shipley and Wislocki jointly, interested in the chemical products of the poison glands of *Bufo agua,* a tropical toad, describe the histology of these epinephrin-producing glands. In the twenty-sixth and last contribution, Kunitomo deals with the retrogression of the caudal end of the spinal cord and the decline of the tail in human embryos.

The contributions are irregularly grouped in small volumes which are sold separately. Doubtless it would be appreciated if a limited number of the separate articles were offered to embryologists, though every institution needs the complete file. Altogether it is a journal to be studied by those responsible for our anatomical publications. When the *American Journal of Anatomy* was founded and was being published in Baltimore largely under Mall's direction, it seemed that nothing better was likely to appear in this country. But as the *Journal* became securely established, losing —perhaps we imagine it—the enthusiasm of the earlier volumes, Mall's genius for publications sought new fields. His *Contributions* have caught in beautiful form and permanent record the spirit and purposes of current American investigations in embryology, and their future is full of promise.

Frederic T. Lewis
Harvard Medical School

SPECIAL ARTICLES

NOTE ON THE TECHNIQUE OF SOLUTION CULTURE EXPERIMENTS WITH PLANTS

In recent years a large number of sand and solution culture experiments have been carried out by various laboratories. It is becoming recognized that any complete understanding of soil fertility requires an insight into the absorption and metabolism of the plant as well as the nature of the soil solution. In connection with some investigations relating to the latter question, this laboratory has undertaken a series of studies on the effect of concentration and reaction of the nutrient solution on the growth and absorption of the barley plant. Incidental to this work it has been necessary to examine somewhat critically several phases of the technique employed in sand and solution cultures, and it is desired to present here a number of considerations bearing on the interpretation of these experiments.

Ordinarily the conclusions from such investigations have been based on the concentrations and composition of the solutions as originally prepared. In very few cases have analyses been made of the solutions after contact with the plant, nor of the plants themselves. It is not known therefore exactly what was the condition of the solution during the periods between changes. The percentage

variation in the solution for any given element will depend upon the total quantity absorbed, upon the concentration in the original solution, and also upon the volume of solution provided per plant. It is essential to differentiate between two sets of factors, the composition and concentration of the solution and the total quantities of the various elements present. The effect on the plant might be the result either of the concentration as found in the original solution, or of an insufficient total supply of one or more elements. In order to study the effects of concentration or of composition on plant growth, ideally a continuous flow of solution should be arranged so that the roots are always bathed in a solution of constant composition. Such a technique is ordinarily impracticable, and it is necessary to approximate the desired condition by providing a sufficient volume of solution per plant and by frequent changes. This is particularly true when the object of the investigation is to determine the relative effects of a series of solutions. To give a specific example, certain solutions may have only one tenth of their total concentration due to $Ca(NO_3)_2$. In such a case it is possible that all of the NO_3 might be absorbed before the solution was changed, or at least reduced to a very low level of concentration. Thus, if the interpretation of the experiment is based on three salt triangular diagrams, the effect, actually the result of insufficient NO_3, might be correlated with a certain calcium magnesium ratio.

In some experiments small bottles (250 to 400 c.c.) have been used with three to six plants in each bottle, changes of solution being made every three days, or sometimes only every four or five days. In the sand culture series the size of the jars usually permits the use of only 250 to 400 c.c. of solution per jar. In our experiments (to be described elsewhere) from 500 to 2,200 c.c. of solution per plant (barley) have been used, with changes every two or three days in many cases. Actual determinations of the absorption of each element have been made by analyzing the solutions or the plants. It has been found that under favorable conditions of light and temperature, more than 30 per cent. of the total electrolytes may be absorbed in three days, when 500 c.c. of a favorable nutrient solution of 2,500 p.p.m. concentration is provided for each plant. All of the elements are not absorbed in equal percentages, consequently not only the concentration but also the relation between the elements has been altered. In one experiment with solutions containing 100 p.p.m. NO_3 (500 c.c. solution per plant) barley plants six weeks old absorbed every trace of NO_3 from the solution in less than 72 hours.

In several experiments in which plants have been grown in solution and sand cultures the yields of straw and heads are fairly comparable with those of plants produced in the field, where an excellent crop is obtained. In some sand and solution culture experiments reported the yield per plant has evidently been much inferior to that for similar plants grown in the soil for an equal period. Some limitation of light, temperature, aeration or of the nutrient solution must therefore have existed. In many cases there is a strong presumption that the supply of nutrients may have been deficient, as noted above.

We do not desire, however to criticize any specific investigations. If plants are grown under sub-optimal light or temperature conditions, the total quantities of nutrients absorbed per plant may be much less than in our experiments. Moreover, in the first few weeks the plant has not reached its maximum power of absorption, so that short culture periods will require less quantities of nutrients. The point we desire to emphasize is that plants grown under the most favorable conditions may absorb or require much larger quantities of nutrients per plant than are ordinarily provided in sand and solution culture work. Each set of conditions should be tested by actual analysis of solutions and plants and results interpreted in terms not of the original solution alone, but also in terms of total supply and the varying condition of the solution in the periods between changes. It should also be noted that deficiencies in total

supply in the earlier stages of growth may stunt the plant so that absorption in the later stages is much less than would occur with a normal plant.

D. R. Hoagland

Division of Agricultural Chemistry,
University of California

UNHEATED EGG-YOLK MEDIA

For some years the writer has been using unheated egg-yolk media and has found them especially valuable in studying one of the foulbroods caused by an organism (*Bacillus larvæ*) which offers considerable difficulty in its cultivation. In a paper "Further Studies on American Foulbrood" to be published in the *Journal of Agricultural Research* reference is made to the employment of such media successfully in the study of this species. Believing that the fact might be of interest to those studying diseases caused by organisms for the cultivation of which unheated animal products are being employed and possibly also to those using heated egg media in their work, the technic used in the preparation of these media is given at this time.

These are prepared by adding simply a sterile aqueous suspension of egg-yolk to the different media commonly used in the laboratory. The egg suspension is obtained as follows: After being disinfected the shell of the egg is broken the white poured off and the yolk dropped into a flask containing about 70 c.c. of sterile water. By agitating the flask a uniform suspension of the yolk material is obtained. This is then transferred to sterile tubes by pipetting, and stored until needed. On standing the suspension separates into a more or less translucent supernatant fluid and an opaque lighter yellow-colored sediment.

In preparing the egg media about 1 c.c. of the egg-yolk suspension is added to each 5 c.c. of the base medium. If only the supernatant fluid is used a clearer medium will result. Egg agar has been the most useful of these media in the work referred to. The base should be at least 1.5 per cent. agar and after being liquefied should be cooled to between 45° and 50° C. before the suspension is added. Tubes may be inclined and stored until needed. The medium may be inoculated and plates made, or sterile plates may be poured. Although the pipetting of the sterile suspension rarely results in contamination of the media, if convenient to do so, it is well to test them for sterility after this step is taken. The egg suspension itself is a medium of some differential value.

Eggs known to be recently produced are preferable for the egg-yolk suspension, although those obtained from the market labelled "strictly fresh" have usually been satisfactory. The shell is disinfected conveniently by immersing the egg in a suitable solution for a few minutes. A 1: 1,000 mercuric chloride one is satisfactory for the purpose. Alcohol and solutions of carbolic acid and formalin have been used but the latter two unless gloves are employed are unpleasant to the hands. After removing the egg from the solution, the shell is broken about one end and removed with forceps sterilized conveniently in the direct flame. The white being poured off the limiting membrane of the yolk is broken and the yolk material is poured into the flask containing the sterile water. The degree of transparency of the supernatant fluid depends somewhat upon the amount of water used in making the suspension. Occasionally contaminations are encountered. These are usually detected by changes in the appearance of the suspension following incubation.

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CONTENTS

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THE BOTANICAL OPPORTUNITY[1]

WHEN this program was arranged, it was intended to bring to the attention of botanists how they could serve the nation in the crisis of war. Committees had been multiplied to do various kinds of necessary work. The results were not all that we had hoped for, but botanists were beginning to find themselves, and organization was gradually becoming more effective, because the spirit of cooperation was developing. Enough results were obtained to prove that botany could be of great service at a time of national need. The practical results were not so conspicuous to the public in the immediate activities of the war as those of chemistry and physics for example, but they were fundamental and far-reaching, looking to future as well as to present needs. We must recognize that to bring into effective cooperation great numbers of isolated, scattered, and sometimes conflicting units, takes time and a great controlling motive. But we were making progress, not so rapid as the impatient desired, but probably as rapid as human nature permitted.

Now that the emergencies of war have passed, shall we stop this kind of progress? I wish to attempt to answer this question. In doing so, I shall not formulate any plan, any scheme of organization, but shall present in brief general statement what seems to me to be our opportunity. The other speakers upon the program will doubtless present more concrete suggestions, for which I hope my statement may be an appropriate background.

In connection with the period of reconstruction, there has come to the science of botany a great opportunity, and botanists must rise to the occasion. It is a critical time for our science, for we may lapse into our former state and become submerged by more aggressive

[1] Invitation paper before the joint meeting of botanists at the Baltimore meeting of the American Association for the Advancement of Science.

sciences that will rise to the occasion. This will certainly be our fate unless we make a determined effort. You realize that at the present moment the scientific study of plants is more fully recognized as a great public service than ever before in the history of botany. The recent pressure for food and for a wide range of plant materials and products has been met in the main, not by so-called practical men, but by trained botanists. Not only the practical government service, but also many industries are calling for botanists with fundamental training, realizing as never before that progress is based upon research.

It is the same great opportunity that came first to scientific medicine, through its appeal to the human interest; and later to chemistry in its relation to various industries. It is the appeal of *usefulness,* the appeal that always results in greater opportunity.

A response to this opportunity for public service does not mean *less* science, but *more* science; but it ties up our science so closely to the human interest that it will be in large demand. We are on the rising tide of the greatest demand for trained botanists we have ever known, and it is our task to see to it that the tide does not ebb and leave the profession stranded. If we respond, the opportunities for research will be greater than ever before, as they always are when a science is recognized as of large service. The present endowment for botanical research in universities and in certain industries are as nothing compared with what they will be presently, provided we equip men and women to take advantage of them.

It was my privilege during the war to be present at a meeting of so-called "captains of industry," who were being informed of the contributions that the various sciences could make to the public welfare. The general impression was voiced by one of the auditors in this statement:

> It is obvious that all of our progress in the past has been based on science, and that all our hope of progress in the future must be based on science. It is high time that we begin to pay our debts and give science greater opportunity.

My purpose is to indicate certain things we must stress in ourselves and in our students if we are to rise to the opportunity.

1. *The Synthetic View.*—As we all know, botany has developed many fields of research, and as these fields have multiplied, botanists have become more and more segregated into groups; in fact, in the history of botany we have just been passing through the phase of the *analysis* of our subject. When I began, botany in this country was only taxonomy, and all botanists were interested in the same thing. Then the splitting of the subject began. Different phases gradually became better and better defined, and in consequence more rigid. Presently taxonomists came to know little of any other phase of botany; then morphologists came to know little of taxonomy and to care less; then ecologists and physiologists began to segregate from the rest of us and to narrow their interests, and so for each segregate in turn.

The development of research increased this narrowing process, for it deals with special regions of a general field. For example, in research there came to be as many kinds of morphologists as there are great groups of plants, and so for other fields. This analysis was inevitable and desirable, for it developed technique, the essential equipment for research.

Now, however, the movement is in the other direction. We are passing from the *analysis* of our subject to its *synthesis,* and it is this synthesis that is being called for by the new botanical opportunity. The synthetic view recognizes, not the rigidity of separate fields, but the cooperation of all fields. Every phase of botany must be focused opon our important problems, for we recognize now that every important problem is synthetic. Our superficial separate problems that we have been cultivating have introduced us to the fact that nature is a great synthesis, and must be attacked synthetically. In the days ahead, the botanist who remains narrow will be stranded. We must recognize in every field of botany an important factor in the solution of problems. A man is expected to think

his own field the most important, but if he thinks other fields *un*important, he has blocked his own progress, and is bound to move in ever narrowing circles.

One of the demands upon us, therefore, is to cultivate the synthetic attitude of mind; to develop about our own specialty a penumbra of the botanical perspective. In other words, botanists must cease to be provincial; they must not be citizens merely of one small group, with no larger contacts, but citizens in the world of science. We must not remain persistently in the narrow valley in which our work lies, but we must get on to the mountain top often enough to realize the perspective.

2. *The Practical Outlook.*—The new opportunity demands this; in fact, it was this that created the new opportunity. This means that we are to see to it that botany is recognized as the greatest field for universal service. Medicine holds that position now in public estimation, simply because it ministers to the unfortunate, but they are in the minority. Botanical research underlies an essential ministry to all. Disarticulation of botany from its practical applications has been most unfortunate, and must not be continued. For example, to segregate botany and agriculture as two distinct fields is to damage both; a mistake that our recent experience has emphasized. The result has been that botany has not contributed to agricultural practise as it should; and agricultural practise has not called upon botany as it should. The same is true of the other industries that involve plants. We must recognize that *every* investigation is of possible practical service, and that *every* practise is of possible scientific suggestion. What we have failed to do is to establish the contacts between science and practise, to indicate the possibilities of every advance in knowledge in the way of public service.

This is very far from meaning that every investigation should have an obvious practical application. Research must be absolutely free, stimulated only by its own interest in advancing knowledge, but the importance of fundamental knowledge in solving practical problems should be emphasized at every opportunity.

Our recent experience in connection with emergency problems has shown that no field of botanical investigation is so remote from practical needs that it can not make its contribution if necessary. For example, taxonomy was called upon for information as to new geographical sources and new plant sources for raw products; vascular anatomy was asked to contribute its experience in solving some very important timber problems; ecologists were urged to organize their knowledge so as to be serviceable in relating the suitable crops to soil and climate; physiologists were constantly contributing information as to the possible control of processes essential to plant production. Pathologists did not need so much to demonstrate their usefulness, for their results are obviously practical, and for this very reason it is easier to secure opportunities for research in pathology than for any other of these fields of research. It is not a question of becoming *practical,* but merely of establishing connections that are obvious to the investigator.

We must emphasize, therefore, the connection between what have been called pure science and applied science, which have too long been pigeon-holed into separate compartments. Upon a previous occasion I have emphasized this relationship as follows:

> All science is one. Pure science is often immensely practical, applied science is often very pure science, and between the two there is no dividing line. They are like the end members of a long and intergrading series; very distinct in their isolated and extreme expression, but completely connected. If distinction must be expressed in terms where no sharp distinction exists, it may be expressed by the terms "fundamental" and "superficial." They are terms of comparison and admit of every intergrade. In general, a university devoted to research should be interested in the fundamental things, the larger truths that increase the general prospective of knowledge, and may underlie the possibilities of material progress in many directions. On the other hand, the immediate material needs of the community are to

be met by the superficial things of science, the external touch of the more fundamental things. The series may move in either direction, but its end members must always hold the same relative positions. The first stimulus may be our need, and a superficial science meets it, but in so doing it may put us on the trial that leads to the fundamental things of science. On the other hand, the fundamentals may be gripped first, and only later find some superficial expression. The series is often attacked first in some intermediate region, and probably most of the research in pure science may be so placed; that is, it is relatively fundamental, but it is also relatively superficial. The real progress of science is away from the superficial toward the fundamental; and the more fundamental are the results, the more extensive may be their superficial expression.

It is this situation that we must drill into our students, into ourselves, and into the community.

3. *Cooperation in Research.*—One of the most important by-products of the war has been the proof that if a nation is to develop its maximum strength and efficiency, all of its citizens must join hands and work together; in other words, competition must give place to cooperation. What is true of a nation is true of a science. Our isolated, more or less competitive investgations have resulted in a certain amount of progress; but it has been very slow compared with what cooperation would have secured. The important problems to-day are either too complex for the training of any one investigator, or they call for too many data for one investigator to secure, at least in a reasonable time. In the first case the problem is attacked sporadically from one aspect and then another, the attacks entirely unrelated to one another, and the result is a débris of unorganized results that is more apt to leave the subject in confusion than to clarify it. In the second case the data are either insufficient or are accumulated by an indefinite succession of investigators, probably under fluctuating conditions. As a result, both time and accuracy are sacrificed. Intelligent cooperation would clear up both of these situations and in a comparatively short time reach results that are fairly clear and accurate. Of course, effective cooperation is not possible unless it is voluntary.

This suggests what is probably the most serious obstacle to any general adoption of the cooperative method. We have worked so long in our isolated way in a kind of monastic seclusion, that we have come to regard our problems as personal property, and feel a sort of resentment if any other investigator ventures within our territory. This means that, perhaps unconsciously, we are more concerned with our own personal credit than with the solution of the problem. If our old method has developed this attitude of mind among investigators, it is high time to change it and to realize that research is to advance knowledge, and is not for self-glorification. What the science wants, and what the world wants, is *results,* as quickly and accurately as possible. If we can not be large enough to put truth above ourselves, the outlook for botany is discouraging.

The spirit of competition between individuals is depressing enough, but when it extends to competition between research establishments it is worse. This spirit of aloofness is the more emphasized between institutions that deal primarily with practical questions and those that deal primarily with fundamental research. For example, why should not the investigators of our universities be called upon freely by the Department of Agriculture for the help their training can give; and why should not the university investigators draw freely upon the immense store of practical experience that the Department of Agriculture has collected? Neither set of establishments can do all that is necessary. If each remains in relative isolation, absorbed by its own self-confidence, both science and practise will suffer. Such artificial barriers of self-sufficiency to full cooperation should be broken down that our science and its applications may be free to develop normally. To speak physiologically, we must remove the inhibitions, personal and institutional, and give the stimuli a chance.

In conclusion, if I may venture a prophecy, it would be that if in response to the great

opportunity that has come to us, we shall pledge ourselves to be synthetic rather than narrow in our point of view, to emphasize the possible practical connections of botanical problems, and to submerge our personal and institutional temperaments in a spirit of general cooperation to secure results, botany will come to be recognized as a great national asset, and research will enter upon a new era.

John M. Coulter

University of Chicago

PSYCHIATRY AND THE WAR

The influence of the war upon psychiatry in Great Britain has been profound and shows itself in many different directions. A most important effect has been to draw psychiatry into closer relations with neurology. As an indirect result of the stringency of the lunacy laws there had come into existence in Great Britain a state unknown in other countries, in which a deep gulf existed between those who deal with the insane and those who treat the neuroses, the latter affections usually coming under the care of physicians otherwise occupied with the treatment of organic nervous disease. This gulf has been largely bridged as a result of the war. Both groups of practitioners have been called upon to deal with the enormous mass of psycho-neurosis which the war has produced, with the result that the outlook of each has been greatly widened.

One, and perhaps the most important outcome of this combined activity has been the general recognition of the essential part taken in the production and maintenance of the psycho-neuroses by purely mental factors. In the early stages of the war especial stress was laid on the physical effects of shell explosion, an attitude which found expression in the term shell-shock. As the war has progressed the physical conception of war-neurosis has been gradually replaced by one according to which the vast majority of cases depend on a process of causation in which the factors are essentially mental. The shell explosion or other catastrophe of war, which forms in so many cases the immediate antecedent of the illness, is only the spark which releases deep-seated psychical forces due to the strains of warfare. It has also become clear how large a part is taken in the causation of neurosis by physical factors which only come into action after the soldier has been removed from the scene of warfare.

Not only has war-experience shown the importance of purely mental factors in the production of neurosis, but it has also shown the special potency of certain kinds of mental process, the closely related emotional and instinctive aspects. This knowledge is already having, and will have still more, profound effects upon the science of psychology. This science has hitherto dealt mainly with the intellectual side of mental life and has paid far too little attention to the emotions. Students of certain aspects of mind, and especially those engaged in the study of social psychology, were coming to see how greatly psychologists had over-estimated the intellectual factor. The results of warfare have now compelled psychiatrists to consider from the medical point of view the conflicts between the instinctive tendencies of the individual and the forces of social tradition which workers in other fields have come to recognize as so potent for good and evil in the lives of mankind.

Closely related to this movement is another which has led those dealing with the psychoneuroses to recognize far more widely than hitherto the importance of mental experience which is not directly accessible to consciousness. Warfare has provided us with numberless examples of the processes of dissociation and suppression by means of which certain bodies of experience become shut off from the general mass making up the normal personality, but yet continue to exist in an active state, producing effects of the most striking kind, both mental and physical.

An interesting by-product of this increased attention to the instinctive, emotional and unconscious aspects of mind has been a great alteration in the attitude of psychiatrists to-

wards the views of the psychoanalytic school. Before the war many psychologists were coming to see the importance of Freud's work to their science, but within the medical profession, the general attitude was one of uncompromising hostility. This state of affairs has been wholly altered by the war. The partisans of Freud have been led by experience of the war-neurosis to see that sex is not the sole factor in the production of psycho-neurosis, but that conflict arising out of the activity of other instincts, and especially that of self-preservation, takes an active if not the leading rôle. On the other hand, independent students who, partly through lack of opportunity, had not previously committed themselves to either side, have been forced by the facts to see to how great an extent the nature of the psycho-neuroses of warfare support the views of Freud and have made it their business to sift the grain from the chaff and distinguish between the essential and the accidental in his scheme. To such an extent has the reconciliation gone that it has recently been possible for the chief adherent of Freud to read a communication before the leading medical society of London without exciting any trace of acrimony and only such opposition as must be expected when dealing with a subject as new and complex as that under discussion. There are many signs that the end of the war will find psychiatrists and psychologists ready to consider dispassionately the value of Freud's scheme as a basis for the study of the psychoses as well as of the psycho-neuroses of civil life, ready to accept the good and reject the false without the ignorant prejudice and bitter rancor which characterized every discussion of the subject before the war.

Concurrently with the general recognition of the essentially psychical of neurosis, there has taken place a great development on the therapeutical side. As a result of the war psycho-therapy has taken its place among the resources of the physician. There is still far from general agreement concerning the value of different forms of psycho-therapeutic treatment, but work is steadily going on in testing the value of different methods. In the early stages of the war extensive use was made of hypnotism and hypnoidal suggestion, and owing to the striking character of its immediate results this mode of treatment still has a considerable vogue. The general trend of opinion, however, has been against its employment as tending to undermine the strength of character which is needed to enable the victim of neurosis to combat the forces which have temporarily overcome him. Many of those who used hypnotism largely in the early days of the war have given it up in favor of other less rapid and dramatic but more efficacious modes of treatment.

The treatment which has had most success consists of a form of mental analysis which resembles to some extent the psycho-analysis of Freud, but differs from it in making little attempt to go deeply into the unconscious, except in so far as any dissociation present has been the result of recent shocks of warfare. Attention is paid especially to those parts of experience which without any special resistance become accessible to the memory of the patient, and to seek by means of the knowledge so acquired to demonstrate to the patient the essentially psychical nature of his malady. By a process of reeducation he is then led to adjust himself to the conditions created by his illness.

The knowledge already gained, and still more that which will become accessible when those at present fully occupied with the needs of the moment have leisure to record their experience, will be of the utmost importance to the future of psychiatry. Already before the war a movement was on foot to bring about reforms in the treatment of mental disorder, the measures especially favored being the establishment of psychiatric clinics and the removal of curable and slight examples of psychosis from association with more chronic cases. This movement will be greatly assisted by the knowledge and experience gained during the war. Those in the medical profession who are moving towards reform will gain a large body of support from many members of the laity who have come through

the war to recognize the gravity of the problem. A large body of exact knowledge will be available to assist those whose business it will be to set the care and treatment of mental disorder on a new footing. Psychiatry will emerge from the war in a state very different from that it occupied in 1914. Above all it will be surrounded by an atmosphere of hope and promise for the future treatment of the greatest of human ills.

W. H. R. Rivers
University of Cambridge

INTELLECTUAL INTERCOURSE BETWEEN ALLIED AND FRIENDLY COUNTRIES

In the beginning of 1917, there was founded in Italy, with its seat at the University of Rome, a society having the title: *Associazione italiana per l'intesa intellettuale fra i pœsi alleati ed amici* (Italian society for intellectual intercourse between allied and friendly countries). Its president is Senator V. Volterra, and the names best known in the literature and science of Italy are represented on the committee which directs its work.

The name of the society is self explanatory—in the publication of a quarterly review, entitled *L'intesa intellettuale,* its work has already begun in a definite way. The purpose of the review, which is the same as that of the society, may be explained as follows: (1) More active and frequent intercourse between universities, academies of science, and, in general, educational institutions of the allied and friendly countries; (2) increased teaching of the Italian language in foreign countries, with greater extension in Italy of the teaching of the languages of allied and friendly countries; (3) exchange of teachers of every order and rank; (4) reciprocal acknowledgment of the requirements for admission to the universities and courses of lectures; (5) exchange of students either for special study or to acquire general knowledge of the different countries; (6) to facilitate the exchange of publications and books and to increase knowledge of Italian works; (7) to make known by translation the best Italian works; (8) cooperation in the field of science and its practical applications, and especially in the law in regard to questions of private law; (9) intellectual relations of every kind between people who wish to render more close, durable and fruitful the union of the nations which fought the battles of civilization together.

Some of these purposes coincide with those stated in the outline of the plan for an inter-allied research council proposed by Dr. G. E. Hale. In the National Research Council, founded by him at the beginning of the present war, Dr. Hale planned a constant interchange of methods and results which would secure the complete cooperation of the Allies and the United States, and provide means of reaching common agreement between them in regard to the immediate necessities of the war, and now for the more fruitful works of peace.

Probably in no country other than Italy are to be found so many foreign institutions for research in science, literature, history and the arts. These are of course means of cooperation and exchange, but the exchange is now only on one side owing to the lack of similar organizations for Italian people in foreign countries. The principal difficulty in cooperating with us is certainly that of language; and there is no doubt that the English and Italian speaking peoples should become more familiar with each other's language in order to acquaint themselves better with Italian and English works.

As exchange of teachers and students is one of the best methods of overcoming this particular difficulty, in July, 1917, our Ministry of Public Instruction elected a committee with Senator V. Volterra as its president to study and draft a law regulating the exchange of teachers and the interscholastic relations of Italy with foreign countries. Early in 1918 the committee presented its plan, in a report which gives its fundamental conceptions and principal arrangements. These are given in the first article of the first issue of *L'intesa intellettuale* and are here summarized.

According to its program the committee proposes that an independent office be instituted in the Ministry of Public Instruction to promote and direct the exchange of teachers with foreign countries, to send abroad Italian men of letters for historical or scientific research or to teach, to summon foreign teachers or students to Italy, to regulate fellowships, to provide eventually for the foundation of Italian institutions of higher education outside the boundaries of Italy, and to cultivate in every way our intellectual relations with other nations.

The office will consist of a council and an executive board, with the Minister of Public Instruction as president of both. In the council, composed of twenty-one members, the faculties of the universities, the Minister of Public Instruction with the two general directors of higher and secondary instruction, the Ministry of Foreign Affairs, that of Agriculture, of Industry and Commerce, and the Congress are all duly represented. As the Ministry of Public Instruction is given power to elect two members at large, elements outside the school and state administration may also have representation.

With full autonomy in its deliberations and in the administration of funds which must be assigned by the departments concerned, the office has that freedom necessary to accomplish its varied and delicate functions.

The council issues every year a general program of the various activities of the office, but the really active body is the executive board composed of seven members elected by the council from its own members.

The law which has already been mentioned gives rules for those going to foreign countries to teach or to study, providing for their legal status and for that of foreign professors who come temporarily to Italy for the purpose of teaching. The Italian professors who, by the arrangement of the office and with the approval of the proper ministry, go to foreign countries, are divided into three classes according to the length of time they are to be absent from the kingdom: for less than one year, for more than one year and less than five, or for more than five years. On the foreign professor who teaches in Italy is conferred the dignity of the Italian professor of equal rank, and legal validity is given to his course of lectures, under certain conditions.

The last part of these regulations determines the legal value of studies pursued outside the kingdom, of study of foreigners in Italy, and of the fellowships. In general, studies and examinations taken in state institutions or those of equal rank in foreign countries are accepted as of the same value as studies and examinations taken in schools of the same rank in Italy. The fellowships are not restricted, as hitherto, to graduates, but may also be awarded to university students who desire, for the sake of some special work, to visit laboratories, libraries, or foreign archives. Every year a certain number of fellowships is offered to students and graduates (provided they are of not more than two years standing) of high schools, normal and professional schools, and special institutions, in order to make it possible for them to follow courses of study in foreign countries. Among the advantages of such a plan, by no means the least important will be the preparation of good teachers of foreign languages.

The outline given here offers nothing more that the general plans of an extended program. The law itself will constitute the basis for proposed international conventions to facilitate and promote our intellectual relations with foreign countries, and to extend knowledge of Italy beyond our boundaries on the one hand and, on the other, to gain information about the friendly countries.

To give rapid development to this plan and to cooperate with the state institutions in Italy and abroad for its accomplishment is of course one of the most important tasks of the Italian Association. Probably similar associations in the allied and friendly countries will be able to cooperate with it for this purpose.

The other articles of the first two issues of *L'intesa intellettuale* which reached this country deal with the organization of the

schools and educational institutions in Italy and abroad. These articles are by Piero Giacosa, on the "Institutes of Experimental Sciences" (physics and chemistry); by Pietro Bonfante, on the "New Scientific Degrees"; by Eugénie Strong, on the "Britannic School in Rome"; by Alfredo Ascoli, on a "Legislative Alliance"; by Andrea Galante, on the "English Education Bill of 1917"; by L. Duchesne, on the "Transformation of the University Teaching in France"; by V. Scialoja, on the "Giuridic Entente between France and Italy"; by P. S. Leicht, on the "College of Spain and Flanders in Bologna," and by G. Castelnuovo, on the "Reform of the Engineering Schools in France."

We should soon like to see some articles on the educational institutions and research laboratories of the United States and to learn of their vast development and progress along these lines. We would recommend that American scholars write these articles and in them present also their suggestions for the most interesting studies and fields for research in science, literature and law, and indicate the schools, colleges and laboratories that might most profitably be visited by Italian colleagues and students, in order to begin this intercourse and cooperation from which many advantages are to be expected.

GIORGIO ABETTI

WASHINGTON, D. C.

GEORGE FRANCIS ATKINSON

IN the death of George Francis Atkinson American botany has suffered an incalculable loss. Stricken unexpectedly he died at the beginning of what promised to be his most productive period of activity. Having served for more than a quarter of a century as professor of botany in Cornell University he had only recently been relieved by the trustees of all teaching and administrative duties in order that he might give the remaining years of his life to uninterrupted research. He hoped particularly to be able to complete and put in final form for publication his monographic studies on the fleshy fungi of North America. In the pursuit of this undertaking he had gone without assistants for an extended collecting trip to the far west. Here with characteristic enthusiasm for his work and lured by the surpassing richness of the fungous flora near Mt. Ranier he overtaxed his strength, exposed himself to inclement weather, and contracted a severe cold. This rapidly developed into influenza followed by pneumonia, and he died on November 15, in the Tacoma Hospital at Tacoma, Washington. His end came suddenly and found him alone far from friends and home. After his removal to the hospital, though critically ill, his chief worry concerned the recently collected specimens which he had been forced to leave uncared for in the room of his boarding house. Shortly before he died, in his last delirium, he attempted to dictate to his nurse some notes concerning his fungi. Thus death found him engrossed to the very end in the science which he had so long served and which he loved so well. He lies buried at South Haven, Mich., near the home of his boyhood. Ithaca and Cornell will not see him again. To his friends and colleagues it is a thing incredible that his genial personality and brilliant mind are gone from among us. The words, "Professor Atkinson is dead" have passed from lip to lip and left us almost unconvinced. The memory of him and his work now so clearly before us will serve as a guiding influence through the coming years. It is particularly gratifying to the writer to be able to give here an expression of his appreciation of one whom he revered as a great teacher and valued as a true friend.

Professor Atkinson was born in Raisinville, Monroe County, Michigan, January 26, 1854. He received his preliminary academic training at Olivet College, coming later to Cornell University, from which he was graduated in 1885. The following year he began his scientific career as professor of zoology at the University of North Carolina, and between the years 1886 and 1890 published about fifteen papers in the field of zoology. In 1888 he accepted the professorship of botany and

zoology in the University of South Carolina, and in 1889 became professor of biology and botany in the Alabama Polytechnic Institute. While at the latter institution he published as a bulletin of the Alabama Agricultural Experiment Station perhaps his best known zoological paper on the root-gall nematode, *Heterodera radicicola*. His interests shifted rapidly, however, to the fields of plant pathology and mycology, and in 1892 he returned to his alma mater to accept the position of assistant professor of botany. He became associate profesor in 1893, and at the death of Professor Prentiss in 1896 became head of the department.

During the last twenty-five years of his life, though burdened with the multitudinous duties of teaching and administration, he found time to devote himself to research in various fields of botany. He labored untiringly and published over one hundred and fifty papers concerning his investigations. These reveal an unusually wide range of interests. He was also the author of extensively used text books including, "The Biology of Ferns," "Elementary Botany," "A College Text Book of Botany" and "Mushrooms Edible, Poisonous, etc." He rapidly attained an eminent position among the botanists of the world, and received many honors. He was the first president of the Ameican Botanical Society, and throughout his life took an active part in numerous other scientific organizations. His high standing as a scientist was given formal recognition when in 1918 he was elected a member of the National Academy of Science. He served as a delegate to the International Botanical Congresses of 1905 and 1910 held in Vienna and Brussels respectively, and at these meetings used his influence to obtain legislation making for greater stability and uniformity in botanical nomenclature. He traveled in various countries of Europe studying in the field the fleshy fungi of the different regions, and making the acquaintance of an extensive circle of his European colleagues. He was widely known in other lands as a prominent American student of the fungi.

Although his interests covered many fields of botany his highest attainments were realized in mycology. He was undoubtedly one of the foremost students of the fleshy Basidiomycetes which America has produced. Through years of enthusiastic collecting and study he had acquired a herbarium of specimens and a wealth of photographs and notes which gave him a thoroughly comprehensive grasp of this field. Had he lived to complete the extensive illustrated monograph of this group which he had in process of preparation it would have far surpassed in thoroughness and scope any similar paper on these fungi which has yet appeared in any language. His inability to do so will always remain a source of great regret to his students, and constitutes a very distinct loss to the science of mycology.

In the field of general mycology Professor Atkinson was especially interested in questions of phylogeny. Any newly discovered fungus which promised to supply a transition form from one group to another gained his immediate interest. This interest in phylogeny found expression in his comprehensive papers on the origin of the Phycomycetes and Ascomycetes, and is also reflected in the numerous papers which he and his students published on the ontogeny of the fruit-body in many members of the Agaricaceæ and related groups. The unusual keenness of his reasoning powers and the richness of the fund of knowledge from which he drew his conclusions are revealed in some of the philosophical discussions in these papers. His marvelously retentive memory was at once the admiration and the despair of his students.

He was a man of firm convictions, resolute in setting for himself the highest standards of scientific excellence, and impatient of mediocrity in others. His untiring devotion to his work will long remain an inspiration to those whose fortune it was to know him intimately as teacher or friend. Harry M. Fitzpatrick

SCIENTIFIC EVENTS

THE GERMS OF INFLUENZA AND YELLOW FEVER[1]

Major H. Graeme Gibson, R. A. M. C., who died recently at Abbéville, was a martyr to

[1] From the London *Times*.

science and almost at the hour when, in company with two other workers, Major Bowman, Canadian Army Medical Corps and Captain Conner, Australian Army Medical Corps, he had completed the discovery of what is very probably indeed the causative germ of this influenza epidemic.

A preliminary note regarding this germ was published by these doctors on December 14, 1918, in the *British Medical Journal,* and thus Major Graeme Gibson's work takes precedence over later publications. At the time, however, the proof of the discovery was not complete. It has now been completed, as we understand; and Major Gibson's death furnishes a part of the evidence. His eagerness and enthusiasm led him to work so hard that he finally fell a victim to the very virulent strains of the germ with which he was experimenting. He himself caught the influenza, and pneumonia followed.

The germ belongs to the order of filter-passers and is grown by the Noguchi method. It is reported that monkeys have been infected with it quite easily, and have developed attacks producing small hemorrhages in the lungs a soil quite suitable for the reception of the pneumococcus. The chain of evidence thus seems to be very strong. Further, we understand that the germ closely resembles that described by Captain Wilson in the *British Medical Journal* a few weeks ago. Thus Captain Wilson's work seems to confirm the work of Major Graeme Gibson and his colleagues.

It is interesting to note that this work, which has had such fatal consequences for one of the party, has been conducted by three Army doctors, a member of the British forces, a member of the Canadian, and a member of the Australian. The directors of the Medical Service in France deserve the greatest credit, we learn, for the splendid support they have given these workers, while the Medical Research Committee, working with the Army authorities, has rendered invaluable help.

Attention has been so firmly fixed in these last months upon influenza that an interesting event in the medical world has more or less escaped attention. This is the description by Professor Noguchi of a new germ in connection with yellow fever.

That disease has for long furnished a subject of discussion, because doubt existed as to its exact causation. Dr. Noguchi states that the organism discovered by him belongs to the class known as spirochetes, of which the spirochete of syphilis and that of relapsing fever are other members.

If the discovery is confirmed it will add another link to the wonderful chain of discoveries forged in connection with this disease. The fever was first described in Barbados in 1647. Its dreadful virulence soon earned it its evil reputation, and this virulence became a matter of world-wide concern when in the so-called "great period" of the fever it visited Cadiz in five epidemics, Malaga, Lisbon, Seville, Barcelona, Palma, Gibraltar and other European towns. At Lisbon in 1857 some 6,000 persons died in a few weeks.

The fever remained a mystery up till about 1881, when Dr. Charles Finlay, of Havana, propounded the idea that mosquitoes carried the infection. The view found small support at first, but later Ross's work on malaria reawakened interest in it. Then came the Spanish-American war and the appointment of a commission by the American government to investigate Finley's theory. The workers nominated were Walter Reed, James Carroll, A. Agramonte, and Lazear. They began by collecting the suspected mosquitoes, allowing them to feed on yellow fever patients, and then submitting themselves to the bites. Their labors were crowned with immediate success, though lives of great value were heroically sacrificed. It was proved that the mosquito *Stegomyia fasciata* is the agent of infection, that the virus of the disease is present in the blood during the first days of infection, and that "the germ is so small that it can pass through a Chamberland filter." Infection could not be produced till after several days from the time when the mosquito had bitten the yellow fever patient, so that it was evident that the germ underwent some change in the body of its insect host.

This work furnished the material of the wonderful campaign by which Gorgas cleansed the Panama Canal zone of yellow fever, and so made possible the completion of that work. Gorgas came to Panama from Havana, which he had also cleansed of yellow fever in about a year, though the place was a famous hotbed of the disease. His method was to attack the mosquito in its breeding places and to exclude it as far as possible from contact with fever cases.

Dr. Noguchi's work on filter-passing germs is well known. It is also well known that from time to time the suggestion has been offered that the spirochetes pass through two stages of development, one of these stages being of an extremely minute type. Whether or not this view will receive confirmation through the new discovery remains to be seen. In all matters bacteriological it is necessary to keep an open mind until proof of an absolute kind has been forthcoming.

LECTURES BY PROFESSOR BLARINGHEM

Dr. Louis Blaringhem, professor of agricultural biology at the Sorbonne, and exchange professor at Harvard University for 1918–19, is giving a series of ten lectures in French, beginning on Tuesday, April 15, on "The condition and future of agriculture in France." The lectures will be given in Emerson Hall, on Tuesday and Friday afternoons at 4.30 o'clock. They will be open to the public. The dates and titles are as follows:

Avril 15. Le sol français; variétés des terrains et climats. Crûs.

Avril 18. Grandes cultures: blé, betteraves, pommes de terre, lin.

Avril 22. Prés et bois; amélioration des pâturages; plantation des dunes et des territoires dévastés.

Avril 25. Arbres fruitiers; vignes; volailles. Qualités et débouchés.

Avril 29. Cultures forcées; serres et abris vitrés. Production des fleurs.

Mai 6. La science française et l'agriculture. Engrais chimiques.

Mai 9. La lutte contre les maladies du bétail et des produits fermentés.

Mai 13. La production de nouvelles variétés par des sociétés industrielles.

Mai 16. Le paysan français producteur de crûs. Son éducation, ses aptitudes et ses besoins. Rôle de la fermière.

Mai 20. Avenir et renaissance de l'agriculture française. Emploi des machines. Développement des moyens de transport.

NATIONAL RESEARCH COUNCIL

Members of the Division of Chemistry and Chemical Technology have been nominated as follows:

By the *American Chemical Society:* C. L. Alsberg, Bureau of Chemistry, Department of Agriculture, Washington, D. C.; W. D. Bancroft, National Research Council, Washington, D. C.; C. G. Derick, National Aniline & Chemical Co., Inc., Buffalo, N. Y.; J. M. Francis, Parke Davis & Co., Detroit, Mich.; E. C. Franklin, Leland Stanford Jr. University, Stanford University, Cal.; W. F. Hillebrand, Bureau of Standards, Washington, D. C.; John Johnston, Yale University, New Haven, Conn.; Julius Stieglitz, University of Chicago, Chicago, Ill.; J. E. Teeple, 50 East 41st St., New York, N. Y.

By the *American Electrochemical Society:* Colin G. Fink, 20 2nd St. and 10th Ave., New York, N. Y.

By the *American Institute of Chemical Engineers:* Hugh K. Moore, Research Laboratory, Brown Co., Berlin, N. H.

By the *American Ceramic Society:* Albert V. Bleininger, Bureau of Standards, Pittsburgh, Pa.

By the *Division:* C. H. Herty, 35 East 41st St., New York, N. Y.; G. A. Hulett, Princeton University, Princeton, N. J.; A. B. Lamb, Harvard University, Cambridge, Mass.; A. A. Noyes, Massachusetts Institute of Technology, Cambridge, Mass.; C. L. Parsons, Bureau of Mines, Washington, D. C.; E. W. Washburn, University of Illinois, Urbana, Ill.

THE AMERICAN SOCIETY OF MAMMALOGISTS

The American Society of Mammalogists held its organization meeting in the New National Museum, Washington, D. C., April 3 and 4, 1919, with a charter membership of over two hundred and fifty, of whom sixty were in attendance at the meeting. The following officers were elected: C. Hart Merriam, president; E. W. Nelson, first vice-president; Wilfred H. Osgood, second vice-president; H. H. Lane, recording secretary; Hartley H. T. Jackson, corresponding secretary, and Walter P. Taylor,

treasurer. The councilors are: Glover M. Allen, R. M. Anderson, J. Grinnell, M. W. Lyon, W. D. Matthew, John C. Merriam, Gerrit S. Miller, Jr., T. S. Palmer, Edward A. Preble, Witmer Stone and N. Hollister, editor.

Committees were appointed on: Life histories of mammals, C. C. Adams, chairman; Study of game mammals, Charles Sheldon, chairman; Anatomy and phylogeny, W. K. Gregory, chairman; and Bibliography, T. S. Palmer, chairman. The policy of the society will be to devote its attention to the study of mammals in a broad way, including life histories, habits, relations to plants and animals, evolution, paleontology, anatomy and other phases.

Publication of the *Journal of Mammalogy*, in which popular as well as technical matter will be presented, will start this year.

Any person interested in mammals is invited to become a member of the society, and those who qualify before the next annual meeting will be considered charter members. Every one who desires to have a complete file of the journal should join now. Annual dues are three dollars; life membership seventy-five dollars in one payment.

SCIENTIFIC NOTES AND NEWS

In connection with the semi-centennial celebration of Cornell University a dinner will be given on June 19 by the department of physics and members of the university faculty to Professor E. L. Nichols, who retires from the active work of the professorship of physics.

Professor Jacques Hadamard, of the Collège de France, has accepted an invitation from Yale University to be a Silliman Lecturer in the spring of 1920. M. Hadamard is a distinguished French mathematician who received the honorary degree of LL.D. at the Yale Bicentennial in 1901.

C. Tate Regan has been appointed assistant keeper of zoology in the British Natural History Museum in succession to Mr. W. R. Ogilvie Grant, who has retired.

Professor M. I. Pupin, of Columbia University, until recently Royal Consul General for Serbia to the United States, has gone to France to the Peace Conference.

Dr. C. Hart Merriam has been elected chairman of the U. S. Geographic Board, as successor to the late Andrew Braid.

Eighty trees will be planted in the Caledonia Furnace forest reserve on Arbor Day, honoring Dr. J. T. Rothrock, of West Chester, father of the forestry activities of the state of Pennsylvania, who was eighty years old on April 9.

Dr. Henry Allan Gleason, assistant professor of botany and also director of the Botanical Garden and arboretum at the University of Michigan, has been appointed the first assistant of the director-in-chief of the New York Botanical Garden, succeeding Dr. W. A. Murrill, who has been transferred to the new position of supervisor of public instruction.

The Hemenway fellowship in the Peabody Museum of Harvard University has been awarded for the year 1918–1919 to Eduardo Noguera, assistant director of antiquities in the National Museum of Mexico, and last year a Robert C. Winthrop scholar at Harvard. The Charles Eliot Ware Memorial Fellowship in the medical school for the academic year 1918–1919 has been awarded to Edward Allen Boyden, of Newton Centre.

Dr. Alexander C. Abbott, of the University of Pennsylvania, has been promoted to the rank of colonel. He is now in charge of the sanitary supervision of the territory occupied by the second Army, but expects to be back at the university in the fall.

Captain Elton D. Walker, head of the department of civil engineering of Pennsylvania State College, has returned after more than eighteen months' service overseas.

Captain H. C. Porter, of the Ordnance Department, U. S. A., is now with the Chemical Service Laboratories, at West Conshohocken, Pennsylvania.

Captain R. R. Renshaw, C. W. S., who has been directing a corps of research men in the Johns Hopkins University war laboratory,

will remain at the university for special research work in organic chemistry. Captain Renshaw is professor of chemistry at Iowa State Agricultural College on leave of absence.

Dr. J. Edwin Sweet, professor of surgical research in the medical school of the University of Pennsylvania, has been promoted from major to lieutenant colonel. Colonel Sweet went to France with Base Hospital No. 10.

Lieutenant-Colonel Nelson Miles Black, M. C., U. S. Army, has been designated as officer in charge of the section of head surgery, Surgeon-General's Office, vice Colonel Walter R. Parker.

Lieutenant-Colonel E. G. Zabriskie, of New York City, has been designated senior consultant in neuropsychiatry for the American Expeditionary Forces, succeeding Colonel Thomas W. Salmon, who has returned to the United States for duty in the Surgeon-General's Office. Lieutenant-Colonel Zabriskie went to France as divisional neuropsychiatrist of the fourth division. Subsequently he was consultant in neuropsychiatry to the third and fifth corps and the first army. After the armistice he served as consulting neuropsychiatrist to the Savenay hospital center.

Captain S. T. Dana has resigned from the Army and has resumed his duties with the Forest Service as assistant chief of forest investigations. Captain Dana was on the general staff as secretary of the army commodity committee on lumber, and in charge of determining wood requirements of the army.

Dr. A. L. Walters, lately of the Army Medical Corps, has resumed his old duties as director of the department of experimental medicine, Eli Lilly and Co., Indianapolis.

Dr. Hugh S. Taylor has returned to Princeton University to take up his duties again after service with the British government in the Munitions Invention Department, where he has been engaged on problems connected with the preparation and purification of hydrogen.

Mr. John D. Northrop, of the Geological Survey, has accepted a position with an oil company at Cheyenne, Wyoming.

Mr. E. W. Guernsey, formerly with the Chemical Warfare Service, is now at the research laboratories of the Brown Company, at Berlin, N. H.

Assistant Geologist David B. Reger, of the West Virginia Geological Survey, will spend the next three months in Tucker County, West Virginia, making detailed researches for a county geological report. Local headquarters will be at Parsons, West Virginia.

At an international conference in London, on March 11 to 15, William A. Lippincott, professor of poultry husbandry in the Kansas State Agricultural College, was elected secretary of the International Association of Poultry Instructors and Investigators. He succeeds Dr. Raymond Pearl, of the Johns Hopkins University, who recently resigned.

Professor W. T. Sedgwick, of the Massachusetts Institute of Technology and the Harvard-Technology School of Public Health, will leave Boston on May 1 for California, where he is to give instruction in "Sanitary Science and Public Health Problems" during the summer session of the University at Berkeley. Professor Sedgwick recently has been elected to membership in the International Health Board of the Rockefeller Foundation and also has been appointed directing sanitary engineer, with the grade of assistant surgeon general, in the Reserve of the United States Public Health Service.

At the twenty-ninth annual meeting of the Association of American Medical Colleges, held in Chicago, on March 4, the following officers were elected for the ensuing year: president, Dr. George Blumer, New Haven, Conn.; vice-president, Dr. A. C. Eycleshymer, Chicago; secretary-treasurer, Dr. Fred. C. Zapffe, 3431 Lexington Street. Chicago; chairman of executive council, Dr. Irving S. Cutter, Omaha. An entirely new constitution and by-laws were adopted, the principal differences from the old set of rules being in the requirements, high-school and college premedical, for admission to medical schools. The requirement in physics was reduced to six semester

hours, and in biology it was decided that six semester hours of college work were acceptable for students who had completed a year of biology in high school.

DR. W. W. ROWLEE, of Cornell University, gave an illustrated lecture on "Balsa Wood, its production and uses," at the New York State College of Forestry at Syracuse, on April 2. The lecture included scientific data and experiences gleaned from an eight month's absence in Central America in the employ of the American Balsa Company.

DR. JOHN C. MCVAIL delivered the Milroy Lectures before the Royal College of Physicians of London on March 13, 18 and 20; his subject being half a century of smallpox and vaccination. The Goulstonian Lectures, on the spread of bacterial infection was delivered on March 25, 27 and April 1, by Dr. W. W. C. Topley, lecturer on bacteriology Charing Cross Medical School and the Lumleian Lectures, by Sir Humphry D. Rolleston, on cerebro-spinal fever, were planned for April 3, 8 and 10.

JOHN E. JOHNSON, JR., a director of the American Institute of Mining and Metallurgical Engineers, died on April 4 in Scarsdale, N. Y., of injuries received when he was struck by an automobile earlier in the day. Mr. Johnson was fifty-nine years old. He was the author of books on mining and metallurgical subjects.

DR. MARY SOPHIE YOUNG, for the past eight years instructor in botany and curator of the herbarium in the University of Texas, died on March 5 after an illness of a few week's duration.

THE executive committee of the American Federation of Biological Societies has called the annual meeting for April 24, 25 and 26, 119, at Johns Hopkins Medical School, Baltimore, Md.

IT is announced that the German government has decided to return to China the astronomical instruments which were transported from Pekin to Germany in 1900. Negotiations have been opened for the shipping of the instruments to China.

UNIVERSITY AND EDUCATIONAL NEWS

THE legislature of Nebraska has recently appropriated for the College of Medicine at Omaha for the ensuing biennium a total of $380,000. This amount includes the maintenance of the University Hospital.

A GIFT of $5,000 for a scholarship in the Sheffield Scientific School of Yale University has been made by Mrs. Arthur A. Stilwell, of New York City, in memory of her son, Thomas Vincent Stilwell, who lost his life in the war.

FUNDS have been provided for a scholarship in the department of chemistry of the Univercity of Chicago, to be called "The Joseph Triner Scholarship in Chemistry." It is to be assigned to a Czecho-Slovak graduate of the Harrison Technical School, Chicago.

MR. EMIL MOND has offered to the University of Cambridge £20,000 to be used for the establishment of a chair of aeronautical engineering. The chair is to be designated the Francis Mond professorship of aeronautical engineering after Lieutenant Francis Mond, the son of the donor.

PROFESSOR EDWIN J. BARTLETT, senior professor at Dartmouth College and son of a former president of the college, has resigned from the chair of chemistry which he has held since 1883, his resignation to take effect in 1920. Leave of absence for the second semester has been granted to him.

IT is reported that Sir Arthur Newsholme, the distinguished British physician and author of works on the prevention of disease, has been offered the chair of public health at The Johns Hopkins University.

DISCUSSION AND CORRESPONDENCE

ON SOME PROBOSCIDEANS OF THE STATE OF NEW YORK

AT a meeting of the Geological Society of America in Washington, at the close of the year 1902,[1] the question arose as to the former presence of the mammoth in New York. It was said that, when Theodore Roosevelt, as

[1] SCIENCE, Vol. XVII., p. 297.

governor of New York, had urged that the mammoth should appear on its coat of arms, it was evident that, although a mighty hunter of existing game, he was a bit weak as regards extinct types. Sad to say, it was the members of the society that were a bit weak on this particular type. The following examples appear to vindicate the knowledge of the mighty hunter.

In 1842 J. E. De Kay[2] described a molar tooth of *Elephas primigenius* under the name *Elephas americanus*. It has been found at Pittsford, in Monroe County. In Rochester University there is a molar of the same species which is said to have been found at Williamson, Wayne County. Since the meeting referred to, Dr. Burnett Smith, of Syracuse University, has reported to the present writer a tusk and a tooth from Minoa, Onondaga County.

Of the great elephant known as *Elephas columbi*, a tooth was described from Homer, Cortland County, in 1847.[3] In the American Museum of Natural History, New York, there is a part of a molar which was found near Elmira, Chemung County, and which appears to belong to this species.

In 1843 Mather[4] stated that bones of both the mastodon and of the elephant had been found in Orange County. The identification of the elephant is doubtful. In 1858 Emmons[5] reported that an elephant tooth had been taken from the shore of Seneca lake. To which species this belonged is not known.

It would be interesting to learn when the mastodon (*Mammut americanum*) became extinct. It is certain that the species was widely spread over at least the northern states after the disappearance of the last glacial sheet. In New York they are found in great numbers in the southeast corner and at the western end of the state, in marls and mucks overlying the Wisconsin drift. Along lakes Erie and Ontario they are found on the lakeward side of the Iroquois beach, an indication that the species survived there until the waters had shrunken quite into their present limits.

Professor H. L. Fairchild[6] has recently shown that, while the foot of the Wisconsin glacier was occupying the northern side of Long Island, the sea occupied the remainder of the island: and that during this occupation a thick deposit of stratified drift was laid down. After the ice had retired from the island, probably well toward the north of the state, the region south of the ice sheet began to rise, and Long Island at length became dry land or swamp. In depressions on the surface of these sea-laid deposits, there afterwards accumulated silts and muck; and in these pond deposits at three or four places on the island, there have been found remains of mastodons. In one case at least, at Riverhead, the land had probably risen to nearly its present level, for the mastodon was found between present low and high water. This must have been well along towards the end of the pleistocene.

An interesting case is that of a mastodon found in 1866 at Cohoes, near the mouth of the Mohawk. This skeleton, nearly complete, was mounted by G. H. Gilbert and is yet in the State Museum at Albany. It formed the subject of an essay by James Hall[7] and also the first writing of Gilbert. At Cohoes there are found some hundreds of potholes, some in the bed of the present river, many of them in process of forming, others on the banks a hundred feet or more above the present river and long ago filled up. One of the latter, of irregular form, because of the coalescence of two or more originally distinct holes, proved to have a depth of more than 60 feet, and diameters of 33 and 73 feet. Out of this excavation had been taken thousands of loads of muck, with trunks and branches of decayed trees. At a depth of about 50 feet from the

[2] "Zool. N. Y. Mamm.," p. 101, pl. XXXII., fig. 2.

[3] *Amer. Jour. Agricult. and Sci.*, Vol. VI., p. 31, fig.

[4] Geol. 4th Distr., pp. 233, 636.

[5] Geol. Surv. N. C., East Counties, p. 200.

[6] *Bull. Geol. Soc. Amer.*, Vol. XXVIII., pp. 297–308.

[7] Twenty-first Ann. Rep. N. Y. State Cab., 1871, pp. 99–148, with plates.

original surface there was found the principal part of the skeleton, considerably scattered about, but with the skull nearly intact and with unbroken tusks. The bones lay on a bed of clay, broken slate, gravel and water-worn pebbles. This was probed to a depth of ten feet without finding bottom. The right fore leg of the skeleton was missing, but was later found in another pothole 60 feet farther up stream and at least 25 feet higher. Hall thought that the potholes were of glacial or preglacial origin, but I am assured by Professor Fairchild that they have been drilled since the Wisconsin ice sheet abandoned that vicinity. When the ice began to withdraw, the region was depressed about 350 feet below its present level, as a result of which the site of Cohoes was covered with a thick deposit of sand and clay. As the land slowly emerged, the old Mohawk River (Fairchild's Iromohawk) cut through the estuary deposits and finally reached the underlying Hudson slates. Then under the action of strong currents the drilling of the potholes began. The land had then risen, as Professor Fairchild writes, at least 150 feet. At the same time the stream bed was being worn down into the rock and the falls were moving up stream past the potholes. When the mastodon entered the pothole this had long before ceased being cut; for, as already stated, it had became filled to a depth of at least 10 feet with rock débris. It had quite certainly been abandoned by the river waters, except at times of flood. How now did the mastodon get into that hole? Hall concluded that it had been frozen up in the glacial ice and had been dropped part in one pothole, part in the other. But when those potholes were ready for occupation as a tomb for the mastodon, there was no part of the general glacial sheet from which the cadaver could have reached Cohoes. As a recently dead body it might indeed have been floated down the Mohawk; but the animal could as well have lived and died at Cohoes. We may fairly assume that it had only recently died and was lying on the flood plain not far above the potholes. No disarticulated bones could ever have been distributed as this skeleton was. The bones must, perhaps without exception, have been held together by the ligaments and probably much of the flesh remained. At this moment the river rose and swept the flood plain, carrying the cadaver over the potholes. First the right leg became detached and was swept into the upper one of the two holes; then the remainder of the body was carried on and dropped into the second hole. Here the swirling waters either at once or during subsequent floods scattered the skeleton somewhat. As time went on, all sorts of materials were borne into the potholes during freshets. Possibly some trees growing on their margins fell into them. At any rate, they finally became filled up.

It appears quite certain that when the Cohoes mastodon was buried the deposition of marine sediments in the Champlain and the upper St. Lawrence valleys had largely taken place and the Champlain epoch, about the last leaf of the last chapter of the Pleistocene, had nearly ended. Did mastodons end their career at this stage of geological history or did they continue on into the Recent epoch? It may be impossible to determine this. If they did continue to exist, it might be supposed that remains of them might be found in deposits of marl and muck overlying the Champlain deposits along Lake Champlain, and the St. Lawrence and Ottawa rivers; but the writer has not learned of any such cases. At any rate, the close of the Pleistocene or the beginning of the Recent became an insalubrious time for this species, a mighty race which can be traced back possibly to the Pliocene and which had weathered the vicissitudes of four or five glacial periods. At approximately the same time there perished two species of elephants, the giant beaver (*Castoroides*), the moose (*Cervalces*), and perhaps other great animals.

O. P. Hay

U. S. National Museum

HUMAN FLYING

To the Editor of Science: While engaged in some scientific research, my attention was

called to an editorial article with the above caption, in the *American Journal of Mining,* April 25, 1868, Vol. V., p. 264, which later became the well-known *Engineering and Mining Journal.* A comparison of what is accomplished now with the scientific view of that day, a little over fifty years ago, may prove interesting to the readers of SCIENCE.

In part, the article states:

> Inventors have puzzled their minds for ages to compass the problem of air navigation by machines or by flying men; and but little advance has been made. . . . It would of course be absurd to affirm that anything could not be done, in this age of the world; but while this feat may be accomplished to an extent "enough to say so," we are incredulous of any practical benefit of the thing to man. . . . The force which a man is able to expend in rapid ascension of heights, even with the firm earth under his feet, is very small; and we have never seen any principle elucidated which was able by apparatus to increase his power or lessen his gravity in proportion to it.
>
> The balloon remains; but that, if used, presents such a surface to the atmosphere that it can not be accurately guided without, by means of steam-boilers or other weighty machinery, storing up power for propulsion, in a manner of itself too cumbrous and heavy for successful navigation.
>
> So that, whether it is for his own personal flight through the air or the management of a great atmospheric ship, man seems to be hemmed in on every side by almost insuperable natural difficulties. And besides, even were all this obviated, who would run the risk of accidents at a great height above the earth, beyond the reach of help—but not of gravitation? It is an interesting problem, and may result in pretty scientific toys; but for real helpfulness to humanity we see but little in Aeronautics.

Taking the vast change that has been worked out in the life time of many of us, does it not afford encouragement to our young people to endeavor to solve the many problems lying before them, ere the next fifty years shall pass?

M. E. WADSWORTH,
Dean Emeritus

SCHOOL OF MINES,
UNIVERSITY OF PITTSBURGH

KEEPING STEP

TO THE EDITOR OF SCIENCE: Sound travels about 1,060 feet per second at 0° C., or 265 feet in one fourth second. The soldier next the drummer steps with the drumbeat, the soldier 265 feet in the rear is one fourth second late and has his foot in the air when the foot of the front man is on the ground. This is because they march at 120 steps per minute (2 steps per second), which gives one half a step in one fourth second. Hence the soldier who hears the signal one fourth second late will fall one half step behind. I have seen this in columns turning into Victoria Street from Westminster Cathedral, at Lancaster Gate or Holloway Road, on Salisbury Plain, etc.

When tired out or on rough roads soldiers left to themselves do not keep step; but it is a remarkable fact that the only time they keep perfect step is when they are without sound signals. If the drum begins they lose perfect step at once and the feet are seen to strike the ground in receding waves as the sound passes down the line. If the drum stops, the men in two or three seconds get into perfect step again, and go with a sway and swing absent at other times. The French term it *rapport* or *esprit du corps.* Is there a mutual subconscious force passing between the men? In a short brochure of experiments in such matters to be found at public libraries I have suggested an explanation. Is it the right one? I should be glad to hear from American observers of the phenomena.

WALTER MOORE COLEMAN,
Fellow of the Physical Society of London

HARSTON, CAMBRIDGE, ENGLAND

QUOTATIONS

THE ORGANIZATION OF RESEARCH IN GREAT BRITAIN

IN a paper on the state organization of research, read at a recent meeting of the Royal Society of Arts, Sir Frank Heath, K.C.B., Secretary of the Department of Scientific and Industrial Research, succeeded in compressing into a few pages a lucid amount of the work of his department. His characterization of research in general is, so far as it goes, excellent, and ought to be taken to heart by the

public, but the treatment of a vast and complex subject which approves itself to one thoughtful man can not be expected to satisfy all his readers. If, then, we dwell upon points of disagreement, we are not the less conscious that Sir Frank's paper compares favorably with the lucubrations of most administrators.

In the earlier part of his paper he emphasized the novelty of the departure made by the government in 1915, and, without the assertion in so many words, rather implied that our government has handled the problem of national research with more courage and on more satisfactory lines than did that of the Germans. While we agree that the course followed here since 1915 was the best in the circumstances, we are emphatically of opinion that this is only true in consequence of past errors; that the idea inspiring the memorandum of v. Humboldt, quoted by Sir Frank Heath, is correct, and that the system of the German government was in principle thoroughly sound.

The German ruling caste appreciated the importance of scientific knowledge a century before ours, and conceived that the best way to foster research was to create a number of adequately equipped university departments; they believed that the multiplication of opportunities for disinterested investigation would lead to the production of trained minds capable, in Sir Frank Heath's words, "of extending the powers and capacities of man in relation to the world in which he lives." They had their reward; all that scientific ingenuity and foresight could do to safeguard the Teutonic hegemony was done there was no need of hasty improvisations. The German state system has perished in scenes of death and disaster, but of the many crimes and blunders committed by its makers, the neglect of science is not one. In this country, generations of neglect have compelled us to adopt in our hour of need an expedient which would not have found a single defender if proposed as a normal method of evolution. The courage of the government in 1915, which Sir Frank Heath extols, was the courage of despair; we could not then, we can not now, escape the penalty of a hundred years' sloth. It is too late to build from the ground on the German model, but we need not pretend that we have discovered for ourselves a better model, but should, with humble and contrite hearts, try gradually to improve our temporary structure into something like a real university system, keeping it free from such defects and abuses as in Germany that system revealed in practise; of these the worst was the prostitution of scientific appointments and scholarly reputations to the uses of political propaganda.
—*British Medical Journal.*

SCIENTIFIC BOOKS

Bastardierung als Ursache der Apogamie im Pflanzenreich. Eine Hypothese zur experimenteller Vererbungs- und Abstammungslehre. By ALFRED ERNST, professor of botany in Zürich. Jena, Fischer. 1918. Pp. 650, with 172 figures and 2 plates.

The ultimate practical aim of the theory of mutation is avowedly to discover the means of producing new qualities in plants and animals at will and in arbitrarily chosen directions. Some investigators assume that one of the chief causes of mutation is to be looked for in crossing, whereas others think that crosses are far too rare in nature to have had any appreciable effect in the production of species, except for the polymorphous genera. Obviously the best way to decide between these two opinions is to study the influence of hybridizing on the origin of a new character. The author of this book has attacked this problem from a special side, proposing to try to induce a definite character, viz., apogamy, or the production of seeds and spores without fecundation, by means of artificial crosses. The book does not bring any new results, but a collection and discussion of the facts, available for the choice of the material and the method of experimentation to be used.

From this point of view it may be commended to the student of rich questions. It gives a full description of all known cases of apogamy, including algæ and fungi on one hand, *Marsilia, Antennaria, Alchemilla* and

Hieracium on the other. The doubling of chromosomes, the terminology of parthenogenesis, the nucellar embryos, the lessened fertility and many other effects of hybridizing, as well as those of vegetative propagation are extensively dealt with. From this survey the author concludes that *Chara crinita* seems to afford the best material for further studies and gives an ample review of the mode of propagation of this algæ.

It is a dioecious plant, which has a parthenogenetic variety. The latter has been described by *Alexander Braun* as early as 1856 and since by numerous authors. The species is rather rare; in some stations it is found without the variety but in the larger number of localities only the apogamous form occurs. In some, however, both grow together, indicating the possibility of a repeated origin of the variety from the dioecious type. Moreover it is shown that the differences between the two types are of such a kind, that they can not have originated slowly and gradually but must be assumed to be due to a sudden change (p. 104). This is the well-known way in which in other cases mutations are seen to arise. The probable difficulties of the intended investigation are then amply discussed. To these the reviewer might add the objection that it is a species which has already produced an apogamous form, and probably more than once and which therefore may be expected to repeat the mutation from time to time, even without the aid of experimental interference. Furthermore, the experience with the evening primrose has shown that mutations occur in crossed progeny as well as in pure lines and the research of Baur on *Antirhinum* and of Morgan on *Drosophila* have amply confirmed this result. Among hybrid progenies they seem to be more numerous, but only in consequence of the fact that such cultures usually embrace many thousands of individuals more than are kept in the pure stocks. The same will be the case in the cultures of *chara crinita* and the expected occurrence of apogamous mutations in hybrid families can, therefore, not be regarded as a proof of their origin by means of hybridization.

But it seems highly desirable that the experimental trials should be made, the more while in any case the gain for the theory of mutation must be expected to be of the highest importance.

Hugo de Vries

Lunteren, Holland

PRELIMINARY REPORT OF EXPERIMENTS ON THE ACTION OF DICHLOROETHYLSULFIDE (MUSTARD GAS) ON THE CELLS OF MARINE ORGANISMS[1]

The toxic action of a sample of "mustard gas" sent us by Major H. C. Bradley, of the Chemical Warfare Service, has been investigated on a number of typical marine organisms, including various swimming larvæ (sea-urchin, starfish, squid, the annelids *Nereis* and *Arenicola*), the developing eggs of sea-urchin and star-fish, the spermatozoa of sea-urchin and starfish, and young and adult fish (*Fundulus*). The most satisfactory objects for experimentation have proved to be the developing eggs of the starfish (*Asterias forbesii*), and most of our work has been carried out with this material. Changes in the rate and character of cleavage in the eggs after treatment with "mustard," the production of abnormalities of form and structure in the larvæ, and the degree of ciliary activity, furnish a very delicate index of toxic action. Valuable information has also been obtained with *Arenicola* larvæ and with small fish (*Fundulus*).

In the experiments with fertilized starfish eggs we have investigated the influence of solutions of the "mustard gas" in sea-water upon the cleavage and early development (up to the gastrula stage). The procedure chiefly employed was as follows: A small quantity of the "mustard gas" (ca. 5 grams) was shaken vigorously with one liter of sea-water in a

[1] This preliminary report in its present form was sent to the Medical Section, Chemical Warfare Service, September, 1918. A more detailed account of these experiments will be published in the near future.

2-liter glass-stoppered bottle. After the finely divided undissolved oil had settled, the clear liquid from the middle of the solution was drawn off, and the action of this saturated solution upon the recently fertilized mature eggs was tested, using varying dilutions (*e. g.*, 1/2, 1/4, 1/8, 1/16 saturated) and varying times of exposure (from one fourth minute to an hour or more). The eggs were exposed to the solutions in glass-stoppered bottles, and at intervals portions were transferred by pipette to dishes of normal sea-water; this water was changed when the eggs had settled. The subsequent course of cleavage and development, as compared with that of untreated "control" eggs, was carefully studied.

The toxicity of "mustard" solutions prepared in the above manner is not constant but decreases with standing, and the more rapidly the higher the temperature. Solutions made at room temperature (20–24°) always prove strongly toxic if used immediately after preparation; if used later the toxic action is less marked, the decline of toxicity being rapid in the first hour and more gradual later. This decline is due to the progressive hydrolysis of the "mustard," which breaks down rapidly in aqueous solution, yielding HCl and residual compounds of low toxicity. The toxicity of a "mustard" solution two days old, in which the acid freed is neutralized by $NaOH$, is not more than one fiftieth of that of the freshly prepared solution, as measured by the comparative times of exposure required to produce a definite impairment of development or a definite proportion of dead eggs in a given time. The attenuation of toxicity, as thus shown by the physiological action of the solution, exhibits a general parallelism with the production of HCl, as measured by titration (with dibromocresolsulphonephthalein as indicator). The essential toxic action is thus due to the undecomposed "mustard" in the solution. This conclusion was confirmed by experiments in which the hydrolysis of the compound was retarded by cold. The oil was shaken with ice cold sea-water (below 3°), the solution was filtered free from the residual undissolved crystals of "mustard" (which is solid at this temperature), and the cold saturated solution thus obtained was kept at 0° (surrounded by ice in the refrigerator). The toxic action of a portion of the solution kept thus cold and brought to room temperature immediately before adding the eggs was compared with that of portions which were brought to room temperature and allowed to stand for varying times (*e. g.*, 1/4 hour, 1/2 hour, 3 hours, 24 hours) before using. In all cases solutions which were kept cold until just before using were decidedly the most toxic, 15 minutes' exposure to room temperature reduces toxicity by about one half, and 30 minutes by two thirds or three quarters. The decline in toxicity is thus at first rapid, then more gradual; the same is true of the production of acid as shown by titration. The reaction is apparently mono-molecular.

Our experiments favor the following conception of the mode of action of "mustard" upon the living cell. The undecomposed "mustard gas" is slightly soluble in water (according to our titrations of completely hydrolyzed solution to the extent of ca. .05 per cent.). This dissolved "mustard" readily penetrates the cell, presumably because of its high lipoid-water partition-coefficient, and collects in relatively high concentration in the organic solvents of the protoplasm (cell-lipoids, fats, etc.). In this situation it serves as a reservoir of toxic material which continually enters solution in the aqueous phases of the protoplasm and is continually being there decomposed. Since by its hydrolytic decomposition it yields acid, the dissolved "mustard" acts destructively on the protoplasm as soon as the available buffer compounds (which normally prevent protoplasmic hyper-acidity) are exhausted. The destructive action is thus due primarily to the HCl freed by hydrolysis. The other decomposition-products are only slightly toxic; this we have shown experimentally by comparing the action of partially or wholly hydrolyzed solutions of the "mustard," from which the acid was removed by neutralization with $NaOH$, with that of the unneutralized solution. The latter solution is always by far the more toxic;

removal of the acid thus removes the greater part of the toxicity. The continued intracellular production of acid from the reserve of lipoid-bound "mustard" renders the compound, once it has penetrated the cell, extremely persistent in its action and difficult to counteract.

The toxic action of "mustard gas" has a prolonged latency, a fact in accordance with the above conception. Fertilized starfish eggs treated for a few minutes (up to eight minutes) with a freshly prepared weak solution of "mustard" continue to cleave for some hours, at first regularly; later the cleavage becomes irregular and the eggs break down and disintegrate. If acid derived from the progressive hydrolysis of "mustard" contained as reserve in the cell-lipoids is chiefly responsible for the toxic effect, the long latent period of action is readily understood. An experiment with adult fish (*Fundulus*) illustrates both the long latent period and the necessity that the "mustard" should be absorbed by the living cells while it is still in the intact or non-hydrolyzed state. Four fish were placed in each of the following solutions: (A) Filtered solution of "mustard" kept at room temperature five days; (B) a similar solution kept at room temperature one day; (C) the same solution as B, but kept at 0° C. and brought to 20° C. one half hour before using; (D) the same solution kept at 0° C. until immediately before using.

Solutions A and B were almost non-toxic; three of the four fish remained alive after five days in the solution; in C all fish were living after three hours, three were dead in eighteen hours, and all in twenty-six hours; in D two were dead and a third dying within three hours. The toxicity is thus an inverse function of the time during which the "mustard" is undergoing hydrolysis.

While the loss of toxicity of an aqueous "mustard" solution corresponds roughly with the decomposition of "mustard" as determined by titration, a lag in loss of toxicity at the end of the curve suggests that in those extremely dilute solutions the organism takes up a larger proportion of the poison than would be anticipated, possibly as a result of adsorption.

The velocity of the toxic action exhibits a high temperature-coefficient similar to that of chemical reactions in general. In one experiment freshly fertilized starfish eggs were placed in two portions of the same "mustard" solution, one (A) kept at 9 to 10°, the other (B) at 21°. From each solution eggs were transferred to normal sea-water after exposures of 1, 2, 4 and 8 minutes. It was found that an exposure of 2–4 minutes at 21° had almost the same effect in preventing development as one of 8 minutes at 9°–10°. All eggs were killed by 8 minutes' exposure at 21°, while most survived this exposure at 9°. The rate of toxic action at 9°–10° is thus about one third of that at 21°. This result suggests that *cold,* in conjunction with the other methods of treatment, may prove to be of service in treating the skin-burns caused by "mustard gas," *i. e.,* it indicates that the temperature of the skin should be kept as low as possible during the treatment (*e. g.,* washing with ice-cold kerosene is suggested).

Experiments on the counteraction of the toxic action by subsequent treatment with weak basic substances which readily penetrate protoplasm (ammonia, aniline) have not yielded very conclusive results. In several experiments fertilized eggs exposed to "mustard" solutions for some minutes and then brought for three or four hours into sea-water containing a little ammonia $n/2000$ (NH_3 in sea-water) showed on the whole a more favorable development than eggs returned directly from the "mustard" solution to sea-water (*i. e.,* larvæ showed less irregularity and more active ciliary movement). This favorable effect of ammonia was distinct but somewhat slight. In other experiments *Arenicola* larvæ treated for some minutes with solutions of aniline in sea-water (of the anæsthetizing concentration, ca. 1/8 saturated), and then exposed to "mustard" solution, proved distinctly more resistant to its toxic action than the control. This effect is probably to be regarded as an example of the general protective or antitoxic action which anæsthetics exhibit

with this organism. It is possible, however, that the basicity of aniline may be favorable; larvæ anæsthetized with alcohols showed some degree of protection, but less marked than with aniline. The after-treatment of poisoned larvæ with aniline solutions proved ineffective.

Treatment with basic substances appears to us to offer the most promising means of counteracting the action of this poison. A substance whose physical properties, solubilities, and rate of hydrolysis resemble those of "mustard," but which yields on hydrolysis a *base, e. g.*, ammonia, instead of an acid, ought theoretically to counteract the action of "mustard" within the cell. Such a compound could be introduced into the lungs in the form of a spray, or applied to the skin in the usual manner. High lipoid-solubility or surface-activity, favoring rapid penetration of cells, would be essential in such a substance. We recommend a systematic search for an organic compound having these properties. Physiological experimentation with such a compound, if it is obtainable, should in our opinion yield important results.

By the use of intravitam staining, and by the injection of aqueous "mustard" solution directly into the body of the starfish egg, strong evidence was afforded that free acid is liberated within the cell.

The intravitam stain used was neutral red. Eggs were treated with solutions of "mustard" oil (in sea-water) sufficiently concentrated to cause subsequent abnormal development, and were then transferred to an extremely dilute solution of neutral red in sea-water. Normal eggs were simultaneously treated with the neutral red solution. For a period of at least half an hour controlled and treated eggs were colored to about the same degree. The treated eggs later became progressively more intensely stained, so that in an hour after the treatment the greater intensity in color of the "gassed" eggs over that of the control was easily recognizable.

The effect of "mustard" and its decomposition-products on the cell-interior was tested by the introduction of a drop of the gas solution into the body of the fertilized egg by means of a micro-pipette. The following results were obtained:

1. Eggs injected with distilled water quickly recover and continue their normal development.

2. Eggs injected with a freshly made saturated aqueous solution of "mustard gas" show no immediate injurious effects but subsequently are inhibited in their development.

3. Eggs injected with a saturated solution which has been allowed to stand at room temperature for over two hours undergo cytolysis, the immediate destructive effect being more marked than that following the injection of the undecomposed solution.

4. Eggs injected with an aqueous solution of hydrochloric acid of the same strength as the decomposed gas solution exhibit approximately the same effect, viz., a more or less extended cytolysis.

These experiments lend substantial support to the view, previously expressed by Marshall and Smith, that mustard gas, in virtue of its lipoid-solubility, penetrates rapidly into the cell-interior where it liberates hydrochloric acid which, in the free state, is relatively incapable of penetrating the cell.

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SPECIAL ARTICLES

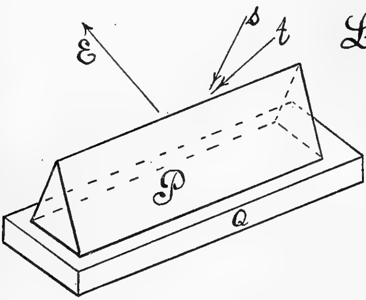
ON HERSCHELL'S FRINGES

HERSCHELL'S fringes, as produced by the familiar apparatus consisting of a right-angled prism reposing with its broad face on a plate of obsidian, present the well-known group of achromatic fringes running parallel to the arc or limit of total reflection. Observation is made in a direction normal to the edge of the prism.

It occurred to me that the phenomenon could be made much more striking and of wider scope, if a long 60°prism were used and observation made in a plane of symmetry *parallel* to the edge of the prism. In the interest of variety, moreover, it is preferable not to em-

ploy strictly accurate surfaces; so that the prisms with which grandfather used to decorate his gas fixtures will, as a rule, suffice admirably. In the figure P is such a prism (truncated) on a plate of obsidian Q, the long edges being normal to a white window curtain at L near by, illuminated with sun light or day light; or any light toward the front, overhead, is good.

The rays that are wanted, s, will enter symmetrically at a mean angle of about 30° to the vertical and after reflection at the base of the prism and the plate, reach the eye in the direction E. The rays totally reflected, t, come from a greater angle to the vertical and are not wanted.



The limit of total reflection here (also easily recognized) is usually a sharp parabolic or cuspidal apex. The light seen through either face enters by the opposed face. On looking down from a steeper angle and with properly selected faces, brilliant groups of complete confocal ellipses (major axis one half to over two inches), of confocal hyperbolae may be seen in each of the roof faces. To find advantageous combinations, the three faces of each prism should be examined in succession, and it is well to rub P on Q to improve the contact. On moving the eye fore and aft or using different pressures, any type of ellipse with white or colored disc may be produced at pleasure. It is usually preferable to use a shorter plate Q than is given in the figure, about one half the length of the prism.

When well produced the ellipses may also be seen by side light, with different patterns in the two roof-faces.

The type of interference figure clearly depends on micrometric differences of the faces in contact. The ellipses are Newton's rings modified by the color dispersion of the glass. The hyperbolae, however, are about equally frequent; but their character is less easily stated. They probably originate in cylindrics. The case of the 45°–90° prism, with the right angled faces respectively horizontal (on the plate) and vertical, is also interesting; for here the ellipses are apt to be *circles* with each of the two groups seen after two reflections, one in each of the orthogonal faces. The light should enter nearly normal to the oblique face. As it leaves in the same way, one should observe through a horizontal slot in a white screen.

I may add a similar observation: If a cylindrical lens (say 1 diopter) is placed on a plate and illuminated with homogeneous light, the interference pattern consists of a succession of equidistant arrow heads along the line of contact, all pointing in its direction. Now these are the very forms observed in the interferences of reversed spectra along the line of coincidence of spectra, except that the latter are apt to be far narrower than the former. It seems therefore, as if the effect of color variation in one case and of the cylindric increase of thickness of air film, in the other, were formally capable of like treatment.

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CONTENTS

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RESEARCH AS A UNIVERSITY FUNCTION[1]

SCIENTIFIC research implies independent and original thinking. It takes for granted that the person has made himself master of recognized facts in the domain where he proposes to extend the boundaries of knowledge, or will proceed to acquire the information. It also takes for granted that every conception is to be tested by material manipulation.

The modern university is derived by integration and adaptation from the learned teaching institutions of early times. As a consequence many medieval features still control the modern institution, often restricting its usefulness. The medieval universities were founded for monks and clerics, who instructed boys and young men in the accepted learning of the times. What they did in the way of adding to the store of knowledge or arranging it for better presentation was done in the quiet of the cloister without thought of reward. In the modern university the investigator may work because he finds pleasure in doing so, and without expectation of encouragement or pecuniary assistance, if he so chooses, but it is the medieval way and not consonant either with the requirements or

[1] The local chapter of the Society of the Sigma Xi in Purdue University, desirous of "encouraging original investigation in science, pure and applied," in accordance with the requirements of its constitution, discussed methods of procedure at a meeting in May, 1918. It concluded that the first thing to do was to make "a survey of the research work in Purdue." Accordingly a committee was appointed, which sent a questionnaire to every member of the instructional force of the university without regard to membership in the society. The report of the committee was presented at a meeting of the chapter January 21, 1919, and the following remarks were made by the president of the chapter as a part of the discussion which followed.

ideals of the present. To extend the boundaries of knowledge as well as of political domains can no longer be done adequately by casual individual effort, as one plays golf, or goes duck hunting, or responds to the love of adventure. There are, however, administrative officers, in fact I am not sure but that the impression is quite general among other persons, who believe that the pleasure of achievement, especially if combined with the approbation of associates, should be considered ample reward for research, even the most prolonged, laborious and costly. The life of the ascetic, comparative poverty, and overwork are preached as the lot to be accepted by the man who delves for hidden lore. It is a musty notion which we as "companions in zealous research" need not countenance.

But the modern world only pays for things that are worth while, not for lore because it is curious or interesting, even when strictly scientific. We hear much at present regarding the value of science. It has been called upon to aid every department of action in the recent war. The very immensity, destructiveness and decision of the conflict rested upon marshaling the achievements of science. It was Germany that led the way, and the rest of the world has opened its eyes to the desirability of cultivating the acquaintance of this much neglected handmaid of national success. Do not forget, however, that Germany's progress in fostering and utilizing science has not been projected over very many years, indeed it has been entirely within the lifetime of the speaker, dating from Liebig's applications of chemistry to agriculture. Leadership is not to be left in German hands unchallenged, if any one may judge by such indications as the establishment in the United States of a National Research Counsel, in England of the Committee of the Privy Council for Scientific and Industrial Research, and of similar organizations in France, Italy and Japan.

But it would seem that the movement to exploit science more fully is directed chiefly to what may be called industrial or applied science, and what is designated pure science must be content to be praised while begging for a crust. As to the distinction between pure and applied science and their relative importance in the welfare of a people I wish to present two illustrations.

I well remember the teaching of my college professor in undergraduate days, showing how organic compounds had such complex molecules, that it would be impossible ever to make them without the aid of the living organism. But eventually indigo was formed synthetically, a most wonderful achievement of pure science, the culmination of more than half a century of effort, and the independent work of hundreds of research chemists. Starting with this result the Badische Company spent seventeen years and five million dollars in industrial research before a pound of indigo could be put on the market.

The indigo of commerce to-day is a possibility realized through the unpaid labor of many men devoted to pure science extending over a long period, followed by the paid labor of fewer workers in industrial science during a much shorter period. It is not necessary to multiply examples to demonstrate what every one knows, that the products of pure science are the material with which applied science works, and that both are needed for advancing the wealth and convenience of the world. It would seem to be the part of wisdom to give equal and abundant encouragement to the workers in both classes of science.

Again I remember the published accounts of the repeated efforts of Professor Langley, of the Smithsonian Institution, to produce a heavier-than-air flying machine. It was difficult to secure funds and even more difficult to awaken intelligent interest. Finally a machine was constructed that flew several hundred feet, and then ignominiously fell into the mud of the Potomac. The daily press found no end of amusement in this episode, and Professor Langley was not able to secure further backing. He was greatly dispirited and mortified, and not long afterward died. Once more, when the Wright brothers of Ohio had so far developed their machine that its capacity for successful flight could no longer be

questioned, the government was unwilling to finance the perfecting of it, and the work had to be completed on the other side of the Atlantic. At the entry of this country into the World War flying machines were greatly needed, and six hundred millions of dollars were largely wasted in experiment before entering upon a course that led to success; a success, however, that placed the first efficient machines in the field just after the fighting was over.

It would seem that the wisdom of preparedness in scientific lines as in others has had a most vivid demonstration in many instances during the course of the Great War. How well it has been learned is yet to be shown in the increased amount of encouragement and support given to both pure and applied science in the days to come. We will see if some of the hundreds of millions of dollars, or possibly billions fortunately conserved by the curtailment of the war will be turned into productive science, or be used for another display of ineptitude.

Most of the members of this society have closer relations with the university, however, than with the government. The purpose of the questionnaire recently sent to the members of the instructional force of Purdue University was to ascertain the attitude of the various individuals toward research, what amount of such work was under way, and what encouragement was being received by them from any source.

The replies show clearly that research is probably favored by all, many are attempting it, and a few succeed. Some persons are not naturally endowed with the qualities that are required by the able investigator, as some do not make good teachers, good administrators, good inventors, etc. A few apparently do not know what sort of effort is required for research. One answers that he does no research because he has not been assigned to it, others say they have no chance to work out their problems. It is undoubtedly true, as I find stated in one of the answers, that "men who are waiting for 'chances' are usually those who have given no objective sign of research ability."

As to the attitude of superiors it appears, except for a few cases, to be favorable, and in some instances most cordial. Part of the feeling that the man above does not support the effort to do original work can probably be ascribed to individual temperament. I find one answering that the attitude of his superior is 'indifferent,' yet the head of this department returns the following statement:

> I feel that not only this university but all institutions of higher learning should encourage research work on the part of its teachers. Nothing should be left undone that could aid in bringing about a healthful activity along this line.

In a department that is not well suited to research one returns the statement that he does none because objection is made by the department, while another says he is engaged in research directed and paid for by the department.

Nevertheless, there seems to be a just and nearly general complaint, except from a few who are in the engineering or agricultural experiment stations, that they are so heavily loaded with routine work that little time or energy is left for research. This brings up the question if it be not a legitimate part of a university man's duty to devote some of his time and strength to extending the boundaries of knowledge, and should not this be recognized and provided for by the university which he serves. What are the functions of a university? The higher institutions of learning are now as they have always been, the source and the disseminators of learning. They have been charged with the two-fold duty of increasing the stock of knowledge and of teaching.

One of the questionnaires brought out this statement: "My ideal of a position is one where most of the time is given to research aided by several interested students, and part of the time taken up with preparing and delivering lectures in courses where one has the benefit of contact with interested students." By adjusting the ratio between teach-

ing and investigation to the subject and to the aptitude of the instructor this would indeed be a generally ideal arrangement, and one by no means beyond the reach of most universities, with due allowance for the "interested students." Every university owes it to itself and to its constituency to maintain a high standard for efficiency, and to attain this a due provision for the encouragement of original thinking and original endeavor is an important factor. The university also owes it to the nation, for a nation that can secure and maintain supremacy in the intellectual field by its contributions to knowledge, its handbooks and treatises, can profoundly influence the course of thought throughout the world, and commands one of the strong elements of national greatness. Mr. W. R. Whitney, of the General Electric Company, said about two years ago:

> The part of research I am most interested in promoting is what we may call the unpaid kind, not because it is cheapest, but because it is most valuable. It is most neglected, most poorly understood, most in need of appreciative support in America. While I am greatly interested in what might be done for science by technical research laboratories in the industries, I am sure that the university must be the important factor in guiding the pioneer work if we are to be a sufficiently advancing nation.

If there be any grain of truth in what was returned upon one of the questionnaires that the university to which we belong, "as an institution [doubtless intending to except the two experiment stations], affords little encouragement and practically no opportunity for research," then this society should exert itself to help in bettering conditions. I am sure the society stands ready to cooperate with the authorities of the university in carrying out whatever program may be found advisable. The committee in its report has made excellent recommendations looking in this direction.

In a statement made last May by the Honorable Elihu Root before the Advisory Committee on Industrial Research of the National Research Council he emphasizes the need of encouragement to research and especially urges a better organization among scientific workers, more cooperation, and a clearer sense of responsibility, closing with the words, "the prizes of industrial and commercial leadership will fall to the nation which organizes its scientific forces most effectively." We need in this institution a more hearty recognition of the importance of research in its reaction upon the individual, of which I have not taken time to speak, in filling a place in the life of the university, and in serving the needs of the nation. If the subject can be estimated at its true value, rather than as an incidental and negligible matter, then time for some work in research for many, if not for all, teachers who may desire it will be forthcoming, even under the most adverse circumstances. One person in answering the question whether investigations are conducted during or outside of school hours says "both, when I can find time which I can not employ better. 'Le temps le mieux employé est celui qu'on perd.'" With a generally accepted high ideal of the value of research that could well be the test for every piece of scientific investigation. It would duly dignify and evaluate the work.

Whether time is to be given to pure or to applied research can best be left to individual choice. One reply reads: "Interested in commercial problems. Do not have much of the scientific spirit of investigation for the pure joy of knowing and of adding to the store of knowledge of the world." But "the pure joy of knowing," the pleasure of accomplishment irrespective of monetary or professional gain, should be the basic incentive for every piece of research, pure or applied. "We are living in the Garden of the Gods, but we are still eating grass," as one writer high in industrial circles visualizes the situation.

I shall venture to close my remarks with the words of Professor Ogden, of Cornell University, speaking recently at the installation of new members into this society on the subject of the purpose of research. I shall, however, take the liberty to reverse the accent placed upon the two forms, pure and applied, as better conveying the general trend of opin-

ion. "May I then express the hope," says Professor Ogden, "that among you," please consider that members of the Purdue Chapter are now intended, "there may be some who will find the subjects for their future experimental work, not only in modern practical applications, in attempted solutions of the many insistent problems of labor, industry and of education, but in abstract research, without thought of reward, carried on in the sole interest of science, that the existence of the university may be more fully justified and the purpose of the Society of Sigma Xi the better realized." J. C. Arthur

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RAPHAEL BLANCHARD (1858–1919)

On February 8, 1919, Professor Raphael Blanchard, of the Paris Medical Faculty, the most eminent medical zoologist and medical historian of modern France, died suddenly of heart failure, at the comparatively early age of sixty-one.

Professor Blanchard was born in the little Tourainian village of Ste. Christophe, on February 28, 1857. He was a great-grandnephew of the famous ballonist Jean Pierre Blanchard, inventor of the parachute, and son of René Blanchard, a dramatic poet, who dying young, left behind him at least one *chef-d'œuvre* of the French stage, the little play of "Pierre Guiffort." Literary and poetic talent was a proper inheritance for the poet's son, who became one of the most distinguished of medical scholars in recent times. A taste for natural science drew young Blanchard to Paris in 1875, where he became attached, a year later, to the histological laboratory of Ch. Robin and Georges Pouchet at the École des Hautes Études. The next two years were spent in Germany, where he studied embryology at Vienna and Leipzig and comparative anatomy at Bonn. Upon his return, he served for a long period as préparateur for the physiologist Paul Bert, at the Sorbonne, and took his medical degree in 1880, with a graduating thesis on anesthesia by nitrous oxide. At the age of twenty-six (1883), he obtained by concours, a professorship in the Paris Medical Faculty. In the meantime, he had published (1883) a little book on the German universities, which was destined to become well known among French educators. Blanchard's scientific career was deeply influenced by his German training, from which he probably acquired his taste for erudition and thoroughness in research. Up to the present war, he was a prominent link between French and German science.

In 1883, in collaboration with Paul Bert, he published a text-book on zoology. In the same year he began his monumental treatise on medical zoology (1885-90), which immediately established itself as the authoritative work on this subject. While the thematic material is mainly parasitology, this work is unquestionably the most comprehensive ever written on the different animals injurious to man. Its geographical and historical details give it a unique place among medical books; the bibliographies attest the wide learning and erudition of the author. With the publication of this work, Blanchard's reputation was established. In 1889, with Milne Edwards, he organized the first international congress of zoology.[1] In 1894, he was admitted to the portals of the Academy of Medicine, an unusual honor for a man of thirty-seven. In 1897, he succeeded Professor Baillon in the chair of medical zoology in the Paris Faculty, and, in 1907, at his request, this chair became specialized as the chair of parasitology. Blanchard made innumerable contributions to parasitology, principally at the Société Zoologique de France, of which he was one of the founders (1876), and for twenty years secretary; and later in the *Archives de Parasitologie,* the most important literary organ of this science, which he founded in 1898 and of which he remained editor until his death. This periodical is everywhere informed by the erudite genius of its editor. To it Blanchard contributed most of his original researches, his many biographies of great parasitologists,

[1] Blanchard was present at the meeting of the Congress in Boston, Mass., August 21, 1907.

living and dead, and many other contributions to the history of medicine. Judged by the illustrations alone, this periodical will always remain one of the most important reference repositories of medical history. Among his other works were monographs on the "Tænia" (1891), the "Coccidia" (1900), a large and important treatise on "Mosquitoes," (1905), a German-French dictionary of anatomical and zoological terms (1908) and a series of monographs on the rôle of insects in infection, which was continued during the recent war in a series of booklets on insects dangerous to soldiers in the trenches, not unlike the series gotten up by Professor A. E. Shipley in England. To anthropology, Blanchard made contributions on "steatopygy in African women" (1883), "the seventh cervical rib of man" (1895), "atavism in man" (1885), "polymastia" (1885) and on "animals injurious to the human race" (1888). Early and late, he did much for medical and zoological nomenclature (1889–1917).[2]

In 1902, Blanchard founded the Institut de médecine coloniale. the first French school of tropical medicine, and in the same year (1902), he also founded the French Society of History of Medicine, a pleiad of talented workers, who met in one of the halls of the medical faculty and whose transactions have been preserved to date. This society has been known to travelers as the most hospitable and attractive of all organizations devoted to this subject, a sort of Mecca for the medical historians.

The last seven years of Blanchard's hard working life were crowned by his great work on medical epigraphy (1909–1915), the intent of which is well described in the subtitle, "Corpus inscriptionum ad medicinam biologiamque spectantium," in other words, no less than a complete collection of all European inscriptions and epitaphs relating to medicine from the time of the Middle Ages down. The plan of this undertaking was originally proposed by Blanchard to the Société française d'histoire de medecine on December 11, 1907, but it was soon discovered that funds were not available and the financing of the proposition was then assumed by Blanchard himself. As it stands, it is one of the most enduring monuments ever made to medico-historical research by the travel method. As far as published, the work comprises some 1,258 inscriptions collected all over Europe and the United States by Blanchard, Wickersheimer and others, each inscription being furnished with an appropriate commentary. Before the appearance of this work, little had been done in medical epigraphy beyond a monograph on medicine in the Roman inscriptions by Jacopo Arata (1902)[3] and a study of the Greek medical inscriptions by J. Oehler (1909).[4] It is now well known that our knowledge of public medicine in antiquity has been largely evolved from the Greek and Roman inscriptions. It is to be hoped that the subject of medical epigraphy will henceforth become an international matter of continuous record and research, to carry out the intention of Blanchard's great work. He was himself one of the noblest advocates of internationalism in science.

Blanchard had been described by those who knew him as a man of the most genial, debonair and attractive type. An engraving in the Surgeon General's Library represents him in the costly vestments of the Paris Faculty, with jabot and dalmatic, his breast covered with many decorations; a towering figure, the countenance expressive of the utmost intellectual refinement. The clean-cut ironic features betoken the type of character which might be either godlike or satanic, but the abiding impression is one of ineffable *bonté de cœur*. In the many group pictures which have appeared, representing Blanchard among his colleagues, he invariably stands out as the *gentilhomme* κατ' ἐξοχήν, as Liszt, Tchaikovski, Saint Saëns did among the musicians. In the decease of this distinguished savant, French science sustains a grave loss.

F. H. Garrison

Army Medical Museum

[2] His last contribution to the subject is in *Bull. Acad. de méd.*, Paris, 1916, LXXVI., 380–389.

[4] Œhler, Janus, Amsterdam, 1909, XIV., 4, 111.

[3] Arata, "L'arte medica nelle iscrizioni latini," Genoa, 1902.

JOHN WALLACE BAIRD

JOHN WALLACE BAIRD, professor of experimental psychology in Clark University, died at Baltimore on February 2, 1919.

Baird was born on May 21, 1869, at Motherwell, western Ontario. From the local school he passed to the high school at St. Marys, and thence to the University of Toronto. His undergraduate course was prolonged, partly by disability due to eye-strain and partly by ventures in teaching; he took his B.A. in 1897.

In his senior year at Toronto Baird came under the influence of Professor A. Kirschmann, who aroused in him the psychological interest that was to dominate the rest of his life. After graduation he spent a further year with Kirschmann, and then—working his passage on a cattle-boat—made his way to Wundt at Leipsic. On his return, he was appointed fellow in psychology at the University of Wisconsin. This appointment was renewed for the following year; but a position fell vacant at Cornell, and Professor Jastrow generously consented to release Baird from his obligations in order that he might accept it. He accordingly came to me as personal assistant in March, 1901, and was made fellow for 1901–02. In 1902 he took his Ph.D. degree. He remained two more years at Cornell, first as assistant in the department of psychology, and then as research assistant on the Carnegie Foundation. From 1904 to 1906 he was instructor in psychology at the Johns Hopkins University, and from 1906 to 1910 assistant professor in the University of Illinois. In 1910 he was called as assistant professor to Clark University, and in 1913 was advanced to the rank of professor.

Baird's productive work is shown by his own writings and by the publications of the students he inspired to have covered a wide range. He spoke with especial authority on the phenomena of visual sensation and perception and on the processes of memory and learning. His interest in vision dates from his Toronto time; a study of abnormal color-sense, published in collaboration with R. J. Richardson in 1898, is, I believe, his first essay in psychological research. He took as the subject of his doctorate thesis the influence of accommodation and convergence on the perception of depth, and his Carnegie Foundation memoir—an admirable bit of work—is an experimental study of the color-sensitivity of the peripheral retina. On the side of memory and learning we have his translation of Meumann's "Psychology of Learning" (1913), and the yearly summaries of experimental papers which he furnished to the *Psychological Bulletin* from 1911 to 1917. Baird's advanced lectures on memory and learning and on the higher intellectual processes would have ripened into books, and indeed would be well worth publishing in the form in which they were last delivered. Unfortunately, he appears never to have written them out in full. He was a born debater, and was openly proud of his ability to speak logically and fluently, on a complex topic, from the scantiest and raggedest of notes. The pride, in a man of extreme modesty, was delightful, and the lectures were always as clear and interesting as he could have wished; but it is doubtful whether enough of their substance can now be recovered to warrant publication. His two latest articles bear witness both to the range of his interest and to the generosity which was an abiding trait of his character. They are entitled "Memory for Absolute Pitch" and "The Rôle of Intent in Mental Functioning," and appear in volumes of essays dedicated to former teachers.

Baird's scientific output, considerable as it was, fails—even if we add his students' work to his own—adequately to reflect his ability and industry. He suffered for many years, and he suffered more than any of us knew, from the malady that was to prove fatal. He seemed able, however, to meet the attacks as they came, and at the time of his marriage in 1914 his friends had reason to hope that his recovery was complete. He threw himself, with zest and humor, into the task of building a house—a house whose hospitality was to rival those other Worcester houses that many psychologists have come to look upon almost as second homes. The house was built, but, alas! was hardly occupied before it was

abandoned. In April, 1918, Baird received an imperative call to Washington, to serve on the committee concerned with plans for the reeducation and reestablishment of disabled soldiers. He devoted himself strenuously to this new work, the burden of which undoubtedly hastened his end. He broke down in November, and did not again leave the hospital.

The loss of a man of Baird's caliber would be a heavy blow to any science at any juncture: it is an especially heavy blow to psychology, whose academic representation is meager and which has recently suffered other and serious losses. His untimely death leaves a gap in our professional ranks, of which we shall become more and more sensible as the years go on. But what is now uppermost in our minds is the feeling of personal bereavement. Baird had, in very exceptional degree, the gift of loyal friendship. He made friends everywhere, with all sorts and conditions of men, and the friendships held; his open and cordial nature, his sturdy optimism, and his frank address, were irresistible. Those who were privileged to be his intimates will miss him sorely. It is a satisfaction to remember that during the last year of his life he received the highest honor his colleagues could bestow, the presidency of the American Psychological Association.

E. B. Titchener

SCIENTIFIC EVENTS

REWARDS FOR BRITISH WAR INVENTIONS

The appointment of a royal commission to determine what awards and royalties shall be paid to inventors in respect of the use of their inventions by government departments during the war is announced in *The London Times*. Mr. Justice Sargant is the chairman of the commission, and its other members are: Professor the Hon. R. J. Strutt, F.R.S., Sir James Johnston Dobbie, D.Sc., LL.D., Mr. G. L. Barstow, C.B., Mr. W. Temple Franks, C.B., Mr. A. Clayton Cole, Mr. H. J. Mackinder, M.P., and Mr. Robert Young, M.P. The commission has now issued, and is published in the *London Gazette*.

Certain special conditions are provided as follows:

1. In any case of user or alleged user of any patented invention for the services of the Crown by any government department and of default of agreement as to the terms of user, the commissioners, upon the application of the patentee and agreement to accept their determination, may proceed to settle,, and may settle the terms of user in lieu and place of the treasury: Provided that the commissioners shall not actually award to the patentee any sum or sums of money whether by way of a gross sum or by way of royalty or otherwise which shall together exceed an aggregate sum of £50,000 beyond and in addition to any allowance the commissioners may think fit to make for outlay and expenses in connection with the invention; but the commissioners, if of opinion that the patentee is fairly entitled to a remuneration exceeding the said aggregate sum of £50,000, may make a recommendation to the treasury as to any such excess, with a statement of their reasons for such recommendation.

2. In any case where terms of user of any patented invention (including any terms as to selling for use, licensing, or otherwise dealing with any article made in accordance therewith, or any terms as to assignment of an invention under section 30 of the Patents and Designs Act, 1907), have been agreed, or are in course of agreement, between the patentee and any government department, the commissioners may on the application of the treasury make any recommendation as to the giving or withholding by the treasury of approval of such agreement or proposed agreement, and may assist in adjusting or determining any term or terms of any proposed agreement as to which the parties may not be fully agreed.

3. In any case of user or alleged user for the services of the Crown by any government department of any inventions, designs, drawings or processes which, though not conferring any monopoly against the Crown or any statutory right to payment or compensation, may nevertheless appear from their exceptional utility or otherwise to entitle the inventor, author or owner thereof to some remuneration for such user (including user or by way of selling for

use, licensing or otherwise dealing with any articles made in accordance therewith) the commissioners may, on the request of the treasury, inquire into the circumstances of the case, and may make a recommendation to the treasury as to the remuneration (if any) that is proper to be allowed therefor.

THE REVISION OF PRITZEL'S BOTANICAL DICTIONARY

PRITZEL in the middle of the last century compiled a dictionary of every important published picture or illustration of every known plant, of which he enumerates more than 100,000, giving a reference to the book and page where each illustration may be found; so that any one hearing of a plant he never happened to have seen could look out the name in "Pritzel," and on referring to the book and page given, find a representation of the plant —colored or otherwise.

Pritzel's book is long out of print, and as he finished his work in 1866 it is desirable to bring Pritzel's work up to date. Different scientific bodies (and private individuals) in England and in the United States have from time to time made suggestions for undertaking this work of revision, but as yet none of their suggestions have taken effect, chiefly on account of the very large expenditures and scientific work it involves.

The original Pritzel, which must of course be reprinted, contains about 100,000 entries, and it is estimated that at least 125,000 more entries will have to be incorporated with them. The Royal Horticultural Society has at last definitely undertaken to carry out the work with the assistance of botanists attached to the Royal Botanic Gardens, Kew, the Natural History Museum and the Linnean Society, and in friendly cooperation with the United States government Bureau of Plant Industry.

In 1913 the society began to raise the required amount, the International Horticultural Exhibition held in 1912 starting the fund with a donation of £250 followed by £100 from the Veitch Memorial Trustees and the council of the Royal Horticultural Society voted £250 to which they have since added another £250 to enable the work to be begun. The work has now been actually started, the typists having accommodation found for them at Kew through the assistance of the director, and the whole is under the immediate supervision of the following committee, viz.: Professor I. Bayley, Mr. E. A. Bowles, Mr. F. J. Hanbury, Captain Arthur W. Hill, Dr. B. Daydon Jackson, Mr. Gerald W. E. Loder, Sir Daniel Morris, Sir David Prain, Dr. A. B. Rendle, Dr. O. Stapf, Sir Harry J. Veitch, to which, as has been said, will be added direct assistance from Kew, the Natural History Museum, the Linnean Society and the Bureau of Plant Industry.

GERMAN SCIENCE AFTER THE WAR

Nature quotes from an editorial in *Die Umschau,* for November 30, 1918, by the editor, Professor J. H. Bechhold, in which he indicates the manner in which German science can aid the Fatherland in its hour of defeat and assist it to gain the supremacy in the economic sphere. After pointing out that reconstructed Germany must perforce be simple in order to conform to the new conditions of life imposed upon her by recent events, he asks the question: In what relation shall science, technics and art stand in the new state? Germany, it is explained, must in future seek to live upon her own resources; further, she will have only a small amount of raw material surplus to her own needs, and for this reason it will be incumbent upon her to export the output of her genius; to meet the situation as it should be met, Germany will have to build herself up on efficiency management. She is told that she must attempt to excel all other countries in the quality of her precision instruments and lenses, artificial silks and textiles, dyes and medicines, high-class furniture and works of art, in order to create a demand for these valuable products of her industry in foreign lands. For this reason, Germany will require, says Professor Bechhold, highly trained engineers, chemists, electricians, skilled mechanics and artificers, and, in order that her needs in these directions may be suitably met, she will further require first-class teachers,

first-class training institutions and research laboratories, as well as colleges. These matters are, it is stated, of such overwhelming importance that they must not be permitted to become a class or caste question; there is little danger of this at the present time for already the intellectual men in Germany are combining forces in various directions: this is so in the case of the technical man and the academician, as well as in that of the artificer and the university professor. Finally, an inventors' institute must be founded in order that the inventor may be furnished with advice, the commercial possibilities of his work tested, a selection made of what is best, and a good market found for that which is of real worth.

APPROPRIATIONS FOR THE KANSAS STATE AGRICULTURAL COLLEGE

The Kansas legislature of 1919 appropriated a total of $1,675,500 for the support of the Kansas State Agricultural College for the biennium July 1, 1919, to June 30, 1921. This appropriation is in addition to the amount set apart for extension and demonstration work in accordance with the terms of the Smith-Lever Act. In accordance with this law, the legislature appropriated $63,073.65 for 1919–20 and $75,203.20 for 1920–21, the federal government supplying a like amount for each year of the biennium. The appropriations for the college proper represent an increase of more than $400,000 or approximately 33 per cent., over the appropriation for the present biennium.

One hundred and ninety thousand dollars was appropriated for completing the central part of Engineering Hall. This will more than double the floor space and will house the electrical engineering department which is now located temporarily in Denison Hall. It will also permit of the proper growth and development of the department of farm engineering. More space will be made available for the physics department, and the chemistry department will be able to expand its quarters. The erection of the new portions of the building will also afford proper coal storage facilities, thus economizing tremendously on labor. Work on the building will be begun at once as the sum of $50,000 is available immediately.

The biennial appropriations also include $12,500 for a new water plant for the college, and $10,000 for a new hog plant, buildings and equipment. Ten thousand dollars will be spent in the two years in testing road materials for the state highway commission, the Agricultural College having been made the official testing laboratory for the commission. Forty thousand dollars was appropriated for repairs and improvements each year—an increase of 60 per cent. over the present appropriation. The appropriation for the support of the Agricultural Experiment Station will be increased from $40,000 to $55,000 each year of the biennium.

SCIENTIFIC NOTES AND NEWS

Dr. George Ferdinand Becker, geologist of the U. S. Geological Survey since 1879, died in Washington on April 20, at the age of seventy-two years.

The Federation of American Societies for Experimental Biology is meeting this week at the Johns Hopkins University, Baltimore. The societies included in the federation are: The Physiological Society, the Society of Biological Chemists, the Society for Pharmacology and Experimental Therapeutics and the Society for Experimental Pathology.

The annual meeting of the Association of American Anatomists was held from April 17 to 19 in Pittsburgh under the presidency of Robert R. Bensley, of the University of Chicago.

The executive committee of the American Society of Zoologists has voted to hold the annual Christmas meeting in 1919 in St. Louis in conjunction with the American Association for the Advancement of Science.

Professor Roland Thaxter, professor of cryptogamic botany at Harvard University since 1901, has been appointed professor emeritus.

The Distinguished Service Medal has been awarded to Colonel John J. Carty "for exceptionally meritorious and distinguished services.

He was largely instrumental in securing from the telephone and telegraph companies of the United States the best talent available to meet the urgent requirements of the Signal Corps at the outbreak of the war. He has served with marked distinction as a member of the American Expeditionary Forces and his brilliant professional attainments and sound judgment have rendered his services of exceptional value to the government."

MAJOR GENERAL SIR ROBERT JONES, lecturer in orthopædic surgery, Liverpool University, will act as honorary consultant to the British Ministry of Pensions for orthopædic cases. Sir Robert Jones is inspector of military orthopædics and has been very largely responsible for the surgical and training arrangements carried out in the special military surgical centers.

MISS LUCY MINNEGERO, of Fairfax, Va., chief nurse of the American Red Cross Unit, which was sent to Kief, Russia, in 1915, and later superintendent of nurses at Columbia Hospital, Washington, D. C., and who since 1917, has been in charge of the preparation of the Red Cross nurses for assignment overseas, has been appointed superintendent of the U. S. Public Health Service Nurse Corps.

PROFESSOR C. M. CHILD, president of the American Society of Zoologists, has nominated and the executive committee has unanimously elected the following members of the society as its representatives in the reorganized Division of Biology and Agriculture of the National Research Council: F. R. Lillie, G. H. Parker and M. F. Guyer.

DR. C. LOVATT EVANS, professor of physiology and pharmacology at Leeds, has resigned to undertake research work in the department of pharmacology and biochemistry of the medical research committee.

DR. SOLON SHEDD, head of the department of geology, State College of Washington, has been granted leave of absence for a year to engage in the production of casing head gasoline in the Oklahoma oil fields.

MAJOR GENERAL WILLIAM C. GORGAS, former Surgeon-General of the Army, and a party of sanitary experts arrived in Panama, on April 3, and left April 7, for Guayaquil, Ecuador, to investigate sanitary conditions.

PROFESSOR HERBERT E. GREGORY, of Yale University, leaves on May 8 for Honolulu to assist the trustees of the Bernice Pauahi Bishop Museum in developing plans for scientific work in Hawaii. By arrangement between the museum and Yale University, Professor Gregory is to be absent from New Haven for the remainder of the present academic year and also during the second half of the year 1919–20.

DR. A. HAMILTON RICE, of Boston, will start early in June on his sixth journey of exploration in South America. The United States government will receive from Dr. Rice the results of his geological discoveries upon his return, as has been the case following each of his previous voyages. His biological and ethnological collections have been presented to the Peabody Museum, Harvard University. To navigate the shallow waters of the Upper Amazon, Dr. Rice has had built a 45-foot launch, which is of 14-foot beam and only 20 inches draught. It will be shipped by freight to one of the South American ports and there assembled. The boat contains living quarters and a laboratory.

AT a meeting of the International Association of Poultry Instructors and Investigators held in London, England, March 11–15, 1919, Edward Brown, Fellow of the London Society, was reelected president, and William A. Lippincott, professor of poultry husbandry, Kansas State Agricultural College, as has been noted in SCIENCE, was elected secretary to succeed Dr. Raymond Pearl. Dr. Pearl recently resigned, since, in becoming head of the department of biometry and vital statistics in the school of hygiene and public health, Johns Hopkins University, he is no longer carrying on investigations with poultry. Dr, Pearl was made first fellow of the association in recognition of his untiring service as secretary since the organization of the association in 1912. By invitation of the Netherlands government, a World's Poultry Congress will be held at the

Hague in 1921 under the auspices of the International Association of Poultry Instructors and Investigators.

Lord Rayleigh, who recently accepted the presidentship of the British Society of Psychical Research, gave his presidential address on April 11.

Professor Francis Carter Wood, director of cancer research under the George Crocker Special Research Fund, Columbia University, lectured on April 15, before the Georgia State Medical Society and the students of Emery University, at Atlanta, Ga.

Dr. C. K. Edmunds, president of the Canton Christian College, spoke at the Cosmos Club, Washington, D. C., on April 14, on "Thirty Thousand Miles in China." The lecture was illustrated by lantern slides. Dr. Edmunds is lecturing on scientific aspects of China at different institutions.

Mr. G. S. Baker has given £500 for the foundation at University College, London, of a prize for the encouragement of botanical research to be named after his daughter, the late Dr. Sarah M. Baker, an old student and member of the staff of the college.

George Carlton Worthen, of the Bussey Institution, Harvard University, known for his work in economic botany, died on April 10, aged forty-eight years.

Dr. Henry Wilde, F.R.S., the English physicist died on March 29, at eighty-six years of age.

Sir Edward Charles Stirling, professor of physiology at the University of Adelaide, and director of the South Australian Museum, died on March 20, aged seventy years.

The *Experiment Station Record* notes that the renewed receipt of scientific literature from Germany brings news of the death of Geheimrat Bernhard Tollens, of the University of Göttingen. He died on January 31, 1918, in his seventy-seventh year. A graduate of Göttingen, Dr. Tollens spent several years as assistant in chemistry at Heidelberg and in Paris, going for a year to Portugal, but returned to Göttingen in 1879 as assistant to the famous chemist Wöhler. Three years later he became director of the Agricultural Chemical Laboratory of the Agricultural Institute, occupying that position up to the time of his retirement in 1911. Professor Theodore Dietrich, known for his work on animal nutrition, was director of one of the earliest German experiment stations, established at Haidau in the district of Cassell in 1857, and removed to Marburg in 1880. He died on October 1, 1917, in his eighty-fifth year.

We learn from *Nature* that at a special general meeting of the Geological Society, held in London on March 26, the following resolution of council was carried by 55 votes against 12: "That it is desirable to admit women as fellows of the society." In submitting the motion, Mr. G. W. Lamplugh, president of the society, said: "It will be within the recollection of most of the fellows that the question of the admission of women to candidature for the fellowship of the society has been raised on more than one occasion in the past. It was considered in 1889 and 1901, and, again, more systematically in 1908–09, when a poll of the fellows was taken and three special general meetings were held, with inconclusive results. It is generally recognized that the course of events since these dates has materially changed the situation. Women have been welcomed to our meetings as visitors, and we have had many examples of their qualifications for fellowships in the excellent papers which they have from time to time contributed to the society. The value of these papers has been appreciated by all geologists, and has been repeatedly acknowledged by the council in its awards. Therefore, in the opinion of the council, it is no longer reasonable to maintain a sex-bar against qualified candidates for the fellowship of the society, and I am empowered by the council to submit the above-mentioned resolution for your consideration."

The summer session of the Hopkins Marine Station of Stanford University, situated on Monterey Bay, California, begins on June 17. This session corresponds to the summer quarter of Stanford University, the first half quarter ending on July 23, and the quarter, August

29. There will be six instructors in attendance and ten regular courses are offered, including work in general zoology and physiology, the classification and ecology of marine invertebrates, economic zoology with reference to marine invertebrates and to fishes, invertebrate embryology, marine botany and special work. An announcement will be sent on application to the Hopkins Marine Station, Pacific Grove, California.

Professor J A. Udden, director of the Bureau of Economic Geology and Technology of the University of Texas, reports that much light upon the possible mineral contents of Texas may be obtained by the keeping of records of the holes that are being drilled in search of oil in various parts of the state. It is the theory of many geologists that large potash beds underlie parts of west Texas, and it is thought that this, or other valuable mineral may be discovered in the wild-cat oil wells that are now being drilled in nearly all the counties of west Texas, though oil is not brought to light. Two years ago the United States government sent seven men, experts in their several branches, to Cliffside, twelve miles north of Amarillo, where a permanent camp was established, a first-class derrick put up, and a complete laboratory established to make exhaustive studies of the salts that might be obtained. The results of this investigation have not been published so far, but it is believed enough has been found to warrant further observations. Potash has been found but not in workable quantities. For the present it is not expected that further explorations will be made by the government. The laboratory established at Cliffside, however, will continue to examine cores from any wells that may be sent in. The Bureau of Economic Geology and Technology of the university has also made similar analyses and will continue to make them.

The Mexico City correspondent of the Journal of the American Medical Association writes that according to recently published statistics, there were 21,915 deaths recorded in the city of Mexico during 1918, and only 7,542 births, which seems to indicate that the population has been reduced by 14,373. But this last figure can not be regarded as accurate because there are always a number of persons who fail to comply with the official regulations for notification in the respective bureaus of the birth of their children. But even making allowance for all this, there is no doubt that the death rate exceeded the birth rate. Influenza was responsible for 1,935 deaths, syphilis for 232, bronchitis for 1,556, bronchopneumonia for 1,456, pneumonia for 2,312, enteritis for 5,496, and various ailments for the other deaths.

Nature states that the Linen Industry Research Association of Belfast is about to appoint a director of research at a salary of not less than £1,000 per year. The selected candidates will be expected to make a survey of the entire field of research in the linen industry, to draft a program of research, and to organize and supervise the carrying out of the scheme.

Two new greenhouses are being completed at the New York Botanical Garden, built through a gift of $100,000 made for the purpose two years ago by Daniel and Murray Guggenheim. These greenhouses form a part of Public Conservatory Range No. 2 on the eastern side of the garden. The larger of the two is designed as a central display greenhouse. Included is a large room where lectures on plant life will be delivered. The smaller of the new greenhouses is designed as an orchid greenhouse to hold the large collection of orchids already accumulated at the garden and others which will be brought from tropical America.

Owing to a reduced appropriation for its work, the American Museum of Natural History finds it necessary greatly to curtail its activities, and announces that one half of the exhibition halls—about 17, it is estimated—have been closed because of lack of funds to pay attendants. The museum is now open from 10 to 4, instead of from 9 to 5, daily. Retrenchment plans include also the elimination of evening lectures in the museum build-

ings and in public schools under the auspices of the museum and a 50 per cent. curtailment of lectures for school children in the museum. All of these measures are designed to cut down expenses for fuel, light, and service, as the minimum appropriation of $240,000 asked for by the museum, figured to cover regular expenses only without provision for further development, has been cut down to $200,00 in the city budget.

By the will of the late Major S. Field Thorn, who died recently in San Francisco, the California Academy of Sciences is to receive "Cragthorn Park," near Santa Cruz, California. The place consists of 242 acres and was Major horn's country home. After the various specific bequests have been paid the academy is to receive the balance of the estate, which it is thought will be considerable. Major Thorn was at one time manager of the Palace Hotel in San Francisco and was for many years interested in the Academy of Sciences.

In connection with the spring meeting of the American Physical Society at the Bureau of Standards, Washington, on April 25 and 26, there will be an exhibit of physical apparatus illustrative of war developments in physics. The exhibit was opened on the afternoon of the 24, all day on the 25 and 26, the evening of the 25 and the afternoon of the 28.

UNIVERSITY AND EDUCATIONAL NEWS

Harvard University and the Smithsonian Institution receive $50,000 each by the will of Mrs. Virginia Purdy Bacon. Columbia University receives $25,000 for scholarships.

By the will of Alexander Cochrane, late of Boston, and head of the Cochrane Chemical Company, Peter Bent Brigham Hospital will receive $10,000 for the establishment of a free bed, and at the termination of a trust fund created for benefit of the members of Mr. Cochrane's family the principal of the trust is to go to Harvard College.

The University of California receives by the will of Mrs. Phoebe Hearst, $60,000, to continue scholarships and a valuable collection of paintings, tapestries and objects of art.

Professor William A. Noyes, head of the department of chemistry of the University of Illinois; Professor Frank Morley, of the Johns Hopkins University, and Professor William T. Sedgwick, of the Massachusetts Institute of Technology, will be included in the faculty of the summer session of the University of California, giving respectively courses in chemistry, mathematics and public health.

At the agricultural college of the University of Idaho, Herbert P. Davis, dairy husbandman, Dairy Division, U. S. Department of Agriculture has been appointed dairyman of the Agricultural Experiment Station, and vice director of the station, and J. E. Nordby, lately first lieutenant in the Motor Section of the Aviation Service, has been appointed associate animal husbandman of the Agricultural Experiment Station, and will have charge of experimental work in animal husbandry.

Captain James Riddick Partington, has been appointed to the newly established university chair of chemistry, tenable at East London College.

Nature states that Professor Ludwig Jost, of Strasburg, succeeds at Heidelberg Professor G. Klebs, who died last October in his sixty-first year, and Dr. W. Ruhland, of Halle, succeeds Professor von Vöchting at Tübingen.

DISCUSSION AND CORRESPONDENCE

BASIS OF THE GEOMETRICAL MEAN AS A B. COLI INDEX

Could I have realized that Professor Cairns would honor by mathematical consideration the "Geometrical Mean" (Science, March 8, 1918) method of obtaining a bacteriological index, I should have hesitated to "wander into paths outside my own domain." However, no elaborate discussion of the mathematical relation between the theory of chance variation and the geometrical mean can be expected to induce the empirical bacteriologist to use it as a *B. coli* index. The simplicity of application and practical utility in daily routine will in the end be its recommendation. Still a brief mention of the grounds on which it seemed to

be based may help to establish it until fuller treatment is possible.

Professor Phelps has thrown light on the problem by distinguishing between the distribution of *B. coli* in space and its distribution in time. The former alone is discussed by McCrady[1] in treating of fermentation tubes made from a single sample. The latter furnished the data for suggesting the "geometrical mean," which was based on a large number of samples taken at different times from single sources, as, for example, given points on a river. Both methods accomplish the same practical purpose by obtaining a weighted mean which eliminates the undue influence of positive high dilutions and the results differ from each other only by a factor which is nearly constant. Whether we wish to base the method à priori on the theory of probability or upon the actual form of the data, becomes an academic problem, but in practise the simpler is naturally to be preferred.

The arbitrary application of the conventional theory of chance to physical data can always be questioned. Bertrand in his "Calcul des Probabilités" calls attention to the fact that if a quantity varies as the law of chance, any observed function of that quantity does not, whereas the choice of the quantity is arbitrary. This distinguishes the mathematical theory of probability from the theory of chance variations of observed quantities. The number and magnitude of the forces acting to change a physical quantity may vary according to the law of chance, whereas the observed change is some function of those forces. Generally those forces combine as a product instead of a sum and so it is believed more fundamental that proportional variations instead of absolute variations follow the conventional law. In physics the variations are very small compared to the arithmetic mean value of the observed quantity and the effect may be commonly negligible because the proportional and absolute variations approach each other. The average is in such cases a very good index of the measurement. In biology, and especially bacteriology, the variations, as in the number of bacteria, are many times as great as the mean value and the geometrical effect becomes so pronounced as to require a logarithmic average or a geometrical mean. Francis Galton[2] discovered the wide practical application of this law and McAllister[3] fully discussed it mathematically.

In the end, therefore, we are thrown back upon the data themselves to determine the most fitting method of reduction and, as the Pearson School of statistics teaches, the sole purpose of such methods is to obtain some representative value of the data. Fortunately, Allen Hazen has given us in probability paper, a simple and sufficiently accurate graphical method of analyzing such rough data. Professor Whipple[4] has summarized and plotted a large mass of bacteriological results and shows that they follow a logarithmic probability curve closely enough. The results obtained in the Investigation of the Potomac River[5] show also that the logarithmic summation curves are strikingly symmetrical about the median line. In the results obtained at the Washington Filtration Plant[6] over a five-year period, the distribution of turbidity readings were found to agree with this form of curve, and the bacteriological results are almost parallel. It is further believed that the practical evolution of the geometrical scale of dilutions indicates that where variations are great the arithmetical scale is but an approximation over short portions of the more natural and fundamental geometrical scale.

1 *Jour. Infect. Dis.*, 1915, 17, p. 183.

2 Galton, Francis, "Geometric Mean in Vital and Social Statistics," *Proc. Roy. Soc.*, 29, p. 365, 1879.

3 McAllister, Donald, "The Law of the Geometric Mean," *ibid.*, p. 367.

4 Whipple, Geo. C., "The Elements of Chance in Sanitation," *Jour. Franklin Institute*, Philadelphia, CLXXXII., 37, 205, 1916.

5 Hygienic Laboratory Bulletin No. 104. Table 13, pp. 87–94, and Charts E–H bet. pp. 128–129.

6 Wells, Wm. Firth, "Some Notes on the Use of Alum in Slow Sand Filteration," *Proc. Am. Water Works Assn.*, 1913.

In conclusion, I suggest a simple rule for obtaining the "score" as an approximation to the "geometrical mean," namely *Revert dilutions*[7] *and apply Phelps Method.*[8] The process of reversion gives the benefit of geometrically reducing the data, and by applying Phelps' Method one obtains an approximate "Geometrical Mean." This is the principle successfully applied in "scoring" oysters.

William Firth Wells

Sanitary Corps U. S. A.

CARDIUM CORBIS A MONŒCIOUS BIVALVE

In the work entitled "Tertiary Fauna of Florida," *Transactions of The Wagner Free Institute of Science of Philadelphia,* Vol. 3, part 5, 1900, p. 1071, William H. Dall makes the following observation with reference to *Cardia:* "Nearly all *Cardia* have two forms, one more equilateral and globose, the other more oblique and elongated, but whether these differences can be correlated with sex is at present unknown."

If attention has been called to the fact that certain species of *Cardia* are monœcious, since Dall made the above statement, the writer of this note is not aware of it.

Variation as mentioned in the above quotation is very noticeable in the common *Cardium corbis* Martyn of the northwest coast. On preparing sections of the visceral region of individuals of this species in recent studies, their hermaphroditic character was clearly shown, masses of ova being interspersed with and sometimes completely surrounded by the spermaries.

I have not had the opportunity of examining other species of *Cardia.* They may or may not be monœcious, but it is evident, from the above observation on *Cardium corbis* Martyn, that variations in this genus must be based upon something other than sexual differences.

C. H. Edmondson

Zoology Laboratory,
University of Oregon

[7] Standard Methods of Water Analyses, Report Committee Am. Public Health Ass'n, 1912.

[8] Phelps, Professor Earle B., *Am. Jour. Pub. Hyg.*, 18, 1908, p. 141.

THE PASSENGER PIGEON

To the Editor of Science: In 1902, 1904 and 1905 I rented a house at Devon, about sixteen miles west of Philadelphia, and on several occasions a single passenger pigeon visited my garden there. Doves came frequently. I was near enough to the passenger pigeon to make mistake impossible. Its color and size would easily distinguish it from the dove, as well as its method of flight and the use of its tail in rising from the ground, which is so much freer than that of the dove, while the shape of its tail would make it impossible to mistake its spread tail for that of a domestic pigeon. I was at Devon again during the summers of 1907 to 1913 inclusive and four or five times saw a single passenger pigeon. The last time was while motoring in 1913. I was running swiftly along a road not far from the woods and a bird got up by the side of the road and after rising from the ground about fifteen feet started off towards the woods. When its flight changed from semi-perpendicular to horizontal I was not twenty yards from it and could clearly see its breast and the under side of its tail and just afterwards the upper side of its tail still spread as the bird changed its course. I could see where it got up on the road and had an excellent idea of my distance, so that I could judge of its size, as well as its color and the shape of the tail.

I have always felt very skeptical about the "scientific" killing off of the last bird of a species which was so broadly distributed and most of whose haunts were so far from the abode of any one who would be likely to write for the papers. It may be what professional scientists would call scientific, but to me, as a business man, it has seemed pretty much like jumping at conclusions and trading on one's ignorance.

F. R. Welsh

QUOTATIONS

THE BRITISH BIRTH RATE

It is very difficult to bring home to people the meaning of a tendency so long as that tendency can only be expressed in figures. Yet

few, we think, can read the latest returns of the Registrar-General without realizing that, so far as population is concerned, all is not well with our state. These figures—the quarterly return of marriages, births and deaths—reveal the outstanding fact that last quarter for the first time since the establishment of civil registration the number of deaths exceeded the number of births. The excess was 79,443. The average excess of births over deaths in the fourth quarter of the three preceding years was 44,785.

This lamentable state of matters requires, however, to be viewed in the light of the influenza epidemic. The Registrar-General regards influenza as a primary or contributory cause of death in no fewer than 98,998 instances, or 41 per cent. of the total deaths registered last quarter.

Influenza, however, by no means completely accounts for the fact that the relationship between birth-rate and death-rate is not improving, but is on the contrary getting worse. Even if we deduct all the influenza deaths the situation remains disquieting.

There is one chief remedy—the saving of those children we have. The fact that of 161,775 births in the quarter under consideration 10,367 were illegitimate should not be lost sight of. At present the way of the illegitimate child in a health sense is hard and dangerous. It must, we think, in the national interest be safeguarded. This is an economic and social as well as, perhaps more than, a medical question. But it is not the less on that account urgent.

Medicine can to some extent prevent disease from attacking the child; medicine can not perform miracles. It is a miracle if children brought up in foul and evil surroundings grow up healthy and wholesome men and women. The miracle, incidentally, is usually accomplished not by doctors but by the self-sacrifice and heroism of the mother of the children, who too often loses her own health in the process.

The birth-rate is the lowest on record, even though 8,104 more births occurred than in the fourth quarter of 1917. Marriages increased in the third quarter of 1918 23,710 over the preceding quarter, and 18,672 over the third quarter of 1917.

According to the returns, 662,773 births and 611,991 deaths were registered in England and Wales in 1918. The natural increase of population, by excess of births over deaths, was, therefore, 50,782, the average annual increase in the preceding five years having been 287,664. The number of persons married during the year was 573,614.

The marriage-rate in England and Wales during 1918 was 15.3 per 1,000, the birth-rate 17.7 per 1,000—the lowest on record—and the death-rate 17.6 per 1,000. Infant mortality was 97 per 1,000 registered births.

The number of deaths registered in the last quarter, 241,218 was 127,000 more than in the preceding quarter, and 128,477 more than in the fourth quarter of 1917. The civilian deaths correspond to a rate of 26.8 per 1,000 of the civil population in 1917. The highest death-rate recorded in England and Wales as a whole in any previous quarter was 25.5 per 1,000 in 1846.—The London *Times*.

SCIENTIFIC BOOKS

The Pygidiidæ, a Family of South American Catfishes. By C. H. EIGENMANN. Mem. Carnegie Mus. 7 (5), 259–398; pls. 36–56.

The catfishes described in this excellent monograph are generally burrowers. They are usually characterized by the presence of spines on the opercula and interopercula and the absence of an adipose fin. The opercular spines render the fishes difficult to dislodge from cavities into which they are accustomed to insinuate themselves. Certain specialized types commonly live as parasites in the gill chambers of other fishes and some are even said to enter the urethræ of mammals, including man. *Nematogenys* from central Chile is the most primitive living representative, and resembles the Siluridæ in certain characters. The eighteen other genera are distributed throughout South America. Most pygidiids are slender, slimy fishes "as slippery as the proverbial eel." Eighty-nine species are described; sixty-three being placed in the genus *Pygidium,* which is said to occur "probably in

all mountain streams north of the latitude of Buenos Aires and sporadically in the lowlands."

Though the monograph is intended primarily to give a systematic survey of the fishes included, the writer's interesting style makes many parts very entertaining for the general reader.

A. S. Pearse

THE PARIS ACADEMY OF SCIENCES

The recently issued *Annual of the Académie des Sciences* for 1919[1] records the election of fourteen new members in 1917 and 1918, seven in the former, and the same number in the latter year; none had been chosen from January 19, 1914, to February 26, 1917, an interval of over three years. Of these new members three belong to the section *Géographie et Navigation,* Ernest Fournier, Robert Bourgeois and Louis Fave; two enter the section *Botanique,* Henri Lecomte and P. A. Dangeard; one is credited to the section *Minéralogie,* Émile Haug; one to the section *Médecine et Chirurgie,* Edouard Quénu; one to *Économie Rurale,* Emmanuel Leclainche, and one to the section *Mécanique,* Gabriel Koenigs. In addition there are three chosen for the new division *Applications de la Science à l'Industrie,* namely, Maurice Leblanc, Auguste Rateau and Charles Charpy, and also one new non-resident member, Charles Flahault, of Montpellier. Last, but not least, Marshall Ferdinand Foch was elected *Académicien Libre,* on November 11, 1918, the day on which took place the signing of the armistice between the Allies and the Central Powers, one of the great events of history, and one to which the masterly military leadership of Foch had chiefly contributed.

It is worthy of note that an institution so thoroughly imbued with the most ardent patriotism still retains on its rolls the name of one German as *Associé Étranger,* namely Simon Schwendener of Berlin. There are also nine German *Correspondents* and two Austrians, one of these the great mineralogist, Gustav Tschermak. This shows that whatever may have been the animus displayed by individual scientists in both camps, this great institution, though placed in the vortex of the fearful conflict, did not lose the conviction that science is international and eternal.

In the *Annual* is given an imposing list of the prizes adjudged annually, or at longer intervals, as well as of the special foundations or funds, and also of the medals regularly awarded. Here we have details regarding 94 different prizes, 10 foundations or funds, and 3 medals, the "Arago Medal," last awarded in 1887, the "Lavoisier Medal" of which the last award was in 1900 and the "Berthelot Medal" that has not been adjudged since 1902.

The president of the Académie des Sciences for the present year is M. Louis Guignard, the vice-president being M. Henri Deslandes. As it is an invarable rule that the vice-president succeeds to the presidency in the following year, M. Deslandes will be, if still living, the next president. The perpetual secretaries are M. Alfred Lacroix, elected in 1914, for the department of *Sciences mathématiques,* and M. Émile Picard, elected in 1917, for that of *Sciences physiques.*

K.

[1] "Institut de France, Académie des Sciences, Annuaire pour 1919," Paris, Gauthiers-Villars et Cie, 178 pp, 8vo.

SPECIAL ARTICLES

SOME PHYSICAL IMPROVEMENTS IN NATIONAL ARMY MEN UNDER MILITARY TRAINING[1]

At the present time when the interest of the country is focused on the military policy of the future, it is worth while to record the effects of training on the physique of men who enter the army from civil life. This has been done before in the case of recruits and university men, and data secured from the men who trained for the present conflict constitute interesting material for comparison. It is a matter of common knowledge that civilians usually show an increase in weight and a generally improved condition after a

[1] From the Section of Food and Nutrition, Medical Department, U. S. Army.

period of military training, and the information here given simply reduces this well-known fact to a quantitative basis. Some of the measurements from which this material was derived were made by officers of the Division of Food and Nutrition of the Medical Department, U. S. A., in the course of investigations of the army mess in camps in the United States; the remainder were secured from records of physical examinations at the time the men entered the service. The conditions under which all the measurements were taken were such that no great accuracy can be claimed for them; however, as they were made on a considerable number of men, at various times, and by different persons, such errors as exist will in all probability be compensating.

The first study to which attention will be called was made on the weights of the men of three companies at Camps Dodge, Funston and Grant, respectively, approximately four months after the men had enlisted. At this time, the weights of the soldiers in these companies were secured by Captain Leon A. Congdon, one of the field officers of the division. The original weights of the men, as noted above, were obtained from records of physical examination made at enlistment. The results of Captain Congdon's work are shown in Fig. 1 in the form of distribution graphs. The weights were divided for plotting into groups differing by five pounds, and the number of individuals in each group was noted. Abscissas on the graph represent successive groups increasing in weight toward the right

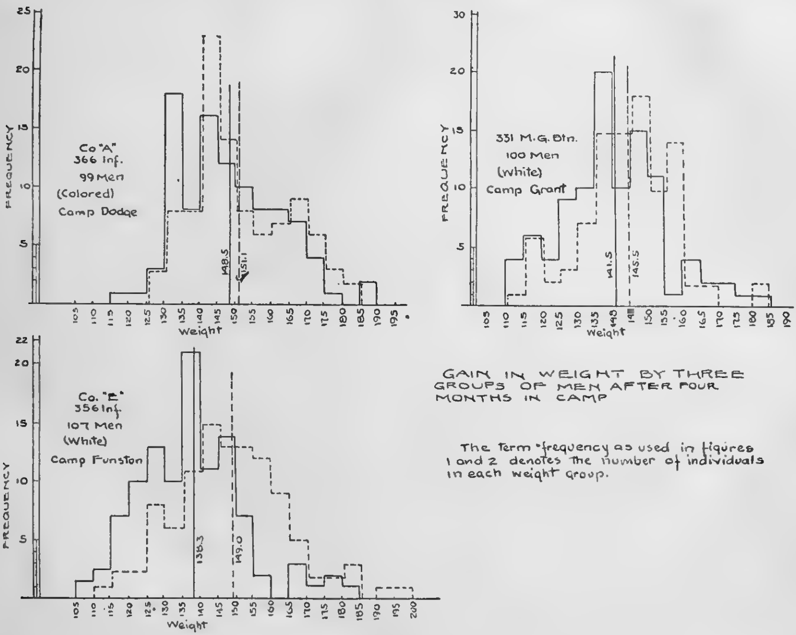

Fig. 1.

and ordinates show the number of men in each group. The number of men in the various weight groups at the time of enlistment is shown for each of the organizations as a solid line while the distribution of weights of the same men after four months is shown as a dotted line. Corresponding averages of the two sets of weights for the three organizations are similarly indicated. It will be noted that the average gain was 2.6, 4.0 and 10.7 pounds for Company A, 366th Infantry, 331st Machine Gun Battalion, and Company E, 356th Infantry, respectively.

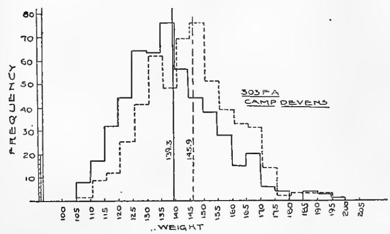

Fig. 2.

A second study of a similar kind was made at Camp Devens by Lieutenant Thurlow C. Nelson under the supervision of Captain J. Garfield Riley on the 303d Regiment of Field Artillery. Fig. 2 shows the distribution graph of the weights of 523 men of this regiment at enlistment and approximately six months later. For the men of this group, chest and height measurements were taken as well as weight. It was found that the height of the group remained approximately stationary, but that chest motility increased on the average 0.7 inches during the five months of training. The increase in motility is considerable, representing as it does a 23 per cent. gain over the average of the men at enlistment.

A third study of gain in weight was made by Lieutenant Wm. A. Perlzweig, Sanitary Corps, on recruits at Camp Pike. A group of National Army men, 257 in number, was selected for study during their first weeks in camp. The typhoid prophylaxis was given in the first two weeks. In the third week the men were divided by the camp authorities into Class A men and Class B men. Class A consisted of those in good physical condition. This class was put at once on a hard training schedule to fit the men for overseas service in the shortest possible time. Class B included men who on account of minor physical defects were continued on the light training schedule that the entire group had formerly undergone, until their defects could be remedied or their classification for limited service branches of the army could be effected. In addition to recording weight changes of these recruits, their average food consumption per

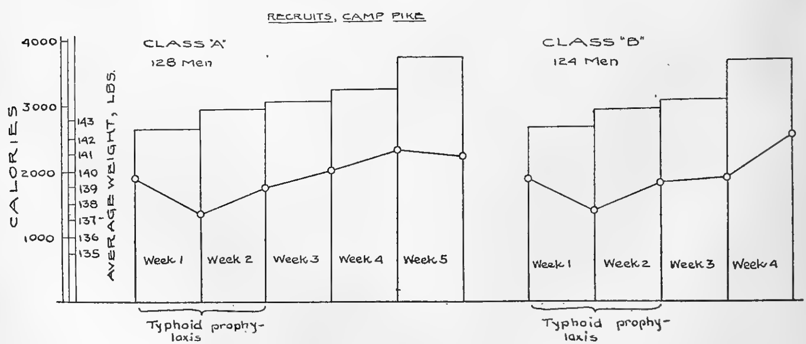

Fig. 3.

week was determined. The investigation covered the first five weeks after enlistment for Class A and the first four weeks after enlistment for Class B, at the end of which periods it was found necessary to discontinue the study. Fig. 3 shows graphically the results obtained. The average energy value per man per day of the food consumed during each week is represented by a series of blocks. The average weight per man was measured at the beginning of each week and at the end of the last week and is shown as a solid line. The scales on which the two quantities are plotted are shown at the left. The noteworthy features of the study are the drop in weight during the first week, in part presumably a result of the typhoid prophylaxis, and subsequent rise for both groups of men resulting in a net increase of 1.4 pounds per man for Class A for a five-week period and 2.6 pounds per man for Class B for a four-week period. The consumption of food in the mess shows a very large increase in both cases. In examining Fig. 3 it should be borne in mind that up to the beginning of the third week the group of recruits had not been divided into Class A and Class B.

It is of interest to compare the averages for these studies with similar averages made in the past. Before doing this it should be stated that all of the groups reported here average approximately 68 inches in height in their stocking feet, and were approximately 25 years of age. All were National Army men, secured by draft from civilian life. The average weight for civilians of this height and age has been determined to be 145 pounds in ordinary clothes.[2] As the army examination uses stripped weight a deduction must be made for the weight of the clothes. Assuming six pounds as the probable value of this, 139 pounds may be taken as the stripped weight of civilians 68 inches tall. According to this standard the men of all the organizations except Company A, 366th Infantry, were about normal in weight at enlistment. In ordinary times recruits for the regular army are drawn chiefly from the laboring classes and show an average weight of approximately 147 pounds for the age and height of the groups here studied.[3] The difference of seven pounds in the average weight of regular army recruits in peace times and these National Army men is probably a result of the changed character of the army due to the draft. It will be noted that Company A of the 377th Infantry consists of colored men; the average weight of these men at enlistment is practically that of the average peace time recruits for the regular army. Also the average rate of gain in weight of this organization is less than in any other of those here studied. With the one exception just noted, all of these National Army men, although they closely approximate the normal civilian weight, made a considerable gain under the rather strenuous training régime of the camp. There is no doubt that this is a gain almost entirely in muscular tissue. A weighted average of the increases made by the three companies shown in Fig. 1 and of the men of the 303d Field Artillery gives 6.4 pounds as the mean increase in body weight for the men of the four organizations. The average weight of these men *after training* (146.8 pounds) is about the same as that of the average peace time *recruit* (145.1). According to Munson the peace time recruit, who is undoubtedly a much more robust type physically than the National Army recruits, gains about 2.8 pounds as a result of three and a half months of military training and the gain of 6.4 pounds of the National Army men is thus not at all surprising. The twenty-three per cent. increase in chest motility shown by the men of the 303d Field Artillery is scarcely second to their weight increase as an index of improvement in physical condition. The men of this regiment showed an average motility at enlistment of three inches. This is a little higher than that shown by the

2 "Medico-actuarial Mortality Investigation," Vol. I. Association of Life Insurance Medical Directors and Actuarial Society of America, New York, 1912.

3 "The Theory and Practise of Military Hygiene," E. L. Munson, New York, William Wood & Co., 1901.

TABLE I

Group	Length of Training Period	Original Weight Lbs.	Weight After Training, Lbs.	Gain, Lbs.	Motility at Enlistment, Inches	Motility After Training, Inches	Gain, Inches
Peace time recruits to Regular Army at Columbus Barracks	$3\frac{1}{2}$ mos.	145.07	147.88	2.81	2.804	3.410	0.606
Civilians (men 68″ tall and 25 years old)	——	139					
523 men of 303 F. A.	6 mos.	139.3	145.9	6.6	3.00	3.70	0.700
99 men (colored) Co. A, 366 Inf., Camp Dodge	4 mos.	148.5	151.1	2.6			
100 white men, 331 Mch. Gun Bn., Camp Grant	4 mos.	141.5	145.5	4.0			
107 men (white) Co. E, 356 Inf., Camp Funston	4 mos.	138.3	149.0	10.7			
Class "A" Recruits, 134 men, Camp Pike	5 wks.	139.54	140.94	1.40			
Class "B" Recruits, 123 men, Camp Pike	4 wks.	139.50	142.07	2.57			

group of regular army recruits mentioned by Munson, whose motility at enlistment averaged 2.8 inches. The regular army recruits increased 0.6 inches in motility as a result of three and a half months' training, while the 523 men of the 303d Field Artillery showed an average increase of 0.7 inch in five months.

The recruit study at Camp Pike indicates the relation between gain in weight and food consumption. It is of course obvious that without proper feeding physical improvement of the men is greatly retarded no matter how favorable other conditions are. It is possible, however, with conditions as they exist in the army, to feed men very satisfactorily from a nutritional point of view and at the same time very economically. A consideration of the remarkable physical gain outlined above of men in the 303d Field Artillery, taken in conjunction with the regimental waste record, shows this very conclusively. During the week of the survey made in order to determine the food consumption of the men of the regiment there was no waste of edible food. This means that every man left the table with an empty mess kit, and that all left-overs from the kitchen were utilized in subsequent meals. While such a remarkable record is exceptional, mess economy in this regiment was at all times of a high order. The beneficial effects of the discipline necessary to secure such results will probably never be lost by the men who were in the organization. The average energy value of the food consumed per man per day in the 303d Field Artillery was 3,699 calories, a figure typical of the consumption found in army messes generally.

RECRUITS, CAMP PIKE

Class	Weight, Average					
	July 1	July 7	July 13	July 20	July 28	Aug. 4
A (134 men)	139.54	137.69	138.93	140.02	141.46	140.94
B (123 men)	139.50	137.78	139.20	139.55	142.07	——

	Food Consumption, Calories per Man per Day				
	July 1–7	July 7–13	July 13–20	July 20–28	July 28–Aug. 4
Class A	2,640	2,931	3,085	3,227	3,715
Class B	2,640	2,931	3,085	3,675	——

The material discussed in the above paragraphs is summarized in Table I. It should be said in closing this article that the *typical* army mess furnishes a sufficient amount of nutritious well-cooked food to meet the requirements of the average soldiers. This is supported by such evidence as has been adduced above and obviously also by the fine army turned out in the training camps of this country for service overseas.

F. M. HILDEBRANDT

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CONTENTS

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COOPERATION BETWEEN ZOOLOGICAL LABORATORIES AND THE GOVERNMENT BUREAUS

The establishment of the Council of National Research and the utilization of a host of other scientific workers from universities and colleges in all sections of the country as parts of the war machinery of the government has for a considerable period and on a large scale brought the college scientists in close contact with the scientists of the governmental bureaus in Washington. This has, I believe, brought about a mutual feeling of friendship and cordial understanding far beyond anything hitherto existing.

Now that the extraordinarily varied scientific work being regularly conducted in Washington under governmental auspices has become more widely known to college workers, the way is open to make this information useful. For instance, would it not be practicable for the head of each college biological or zoological laboratory to make a point year by year to secure first-hand information as to the many lines of governmental work in progress in his branch of science, both as to research problems and as to the application of scientific knowledge to economic work? Probably no field of research offers the student a greater number of subjects of general value to the community.

Possibly the college zoological laboratories might obtain funds, perhaps as fellowships or in other form, with which the more promising students could be given opportunity to visit government laboratories in Washington and elsewhere and become acquainted with government workers in the lines in which they are interested. In this way they could get definite information as to methods of research, the practical handling of various problems and the technique of the leading government

workers, which could not fail to be most helpful in their subsequent studies.

Men of ability could often find opportunity to take up cooperative work in connection with government investigations and eventually many of them would unquestionably join the army of scientific men in the government service, which is helping build up modern agriculture and other forms of food production and conservation, the public health and other beneficial activities.

The extent and variety of the zoological problems being handled by the government bureaus are well illustrated in the activities of the Bureau of Fisheries of the Department of Commerce and in the Bureaus of Animal Industry, Entomology and Biological Survey of the Department of Agriculture, represented here to-day.

The close relationship often existing between technical scientific investigations and the practical application of the knowledge thus obtained is well illustrated by the development of the Bureau of Biological Survey. In its early history the small organization which has since become the present bureau, while taking up certain problems concerning the economic relations of birds, devoted much the larger part of its attention to essentially technical field and laboratory investigations of our native birds and mammals. As the investigations advanced new vistas were opened and numerous practical problems demanded attention. As a natural evolution the technical work became the foundation of the practical work directly for the public benefit.

The facts developed from exact study of the food of birds through microscopic examination of their stomach contents, with field observations on their numbers and distribution, so conclusively demonstrated the value of birds as insect destroyers that public opinion has caused the passage of state laws for their protection throughout the country. The latest result has been a treaty between the United States and Great Britain for the protection of migratory birds in this country and Canada.

The investigators of the food habits of birds must have, in addition to a knowledge of birds, a good working knowledge of insects and of plants. Studies of the food habits of birds are constantly in progress and there is always room for additional investigators in this field.

As the result of the field investigations of the distribution and habits of birds and mammals large series of specimens have been collected and early in the work the fact developed that there existed a surprising lack of technical knowledge concerning our bird and mammal life. In consequence, a number of investigators have been engaged for years in the study of these and other recent collections, and numerous monographs of groups of mammals and shorter papers on birds have been published. These studies have resulted in the discovery of new genera and hundreds of previously unknown species, especially of mammals. The field is still a promising one, particularly as concerns the anatomy, osteology and embryology, and the life histories of most of the species.

The Biological Survey is charged with the administration of the federal laws for the protection of birds, which entails investigations, both technical and non-technical, in order to supply information covering a wide range. Among other tasks it is our duty to determine which species are beneficial and which harmful, and to discover methods for the control of the harmful species.

In addition it is necessary to have definite information concerning foreign birds and mammals, since the law requires that control shall be exercised over the importation of birds and mammals of injurious habits in order to prevent their becoming established here. For example, the colonization of the mongoose in this country would be a calamity of far-reaching effect. At the same time the importation of certain harmless and useful species is encouraged.

With the increased occupation and great extension of farming and stockgrowing throughout the country it has developed that certain native mammals which exist in enormous numbers have become excessively destructive to the crop and meat output. Predatory ani-

mals, such as wolves, coyotes and others, have been killing more than $20,000,000 worth of live stock yearly on the western ranges, while swarming millions of rodents, such as prairie-dogs, ground squirrels, jack rabbits, field mice and others, were destroying farm crops, orchards and forage to the approximate value of $300,000,000 yearly. Through investigations of representatives of the Biological Survey, effective methods have been developed for the destruction of these pests on a large scale. These pests occupy such an enormous area, however, that the cost of handling the problem is a large one. Improvements in this work are still possible and investigations are being continued to devise still more economical and effective methods.

Recently other investigations have been begun to determine with scientific accuracy, through fenced plots of land in the west, the definite amount of injury done to forage production by the principal different kinds of rodents. There is much room for cooperation here and the results will be of the utmost practical value.

The Forest Service finds it impossible in many places to accomplish successful reforesting by seeding until the native mice, and sometimes chipmunks and other rodents in the vicinity, are destroyed. This leads directly to the fact, which has become recognized only recently among a few investigators, that mice and other small rodents, common nearly everywhere and which swarm in surprising abundance over vast areas exercise a great and at times perhaps controlling influence on the character of the vegetation prevailing, including forest production. Dr. MacDougal, of the Carnegie Desert Laboratory, at Tucson, Ariz., informs me that he finds the small desert rodents have a decided effect on the character of the desert vegetation through their destruction of seeds and of the sprouting plants. The exact facts in regard to this relationship between rodents and the native vegetation are not definitely known in the case of a single one among the hundreds of species of these small animals.

The study of our bird and mammal life and its relation to its environment, its distribution and other factors in the life history of the species are in part the object of the biological surveys of the states which the Biological Survey is conducting as rapidly as its means will permit. These investigations include both the field study of the birds and mammals and the technical investigations relating to their taxonomic characters in the laboratory. To enter into investigations such as those mentioned above requires a technical knowledge of the species of birds and mammals.

The house rat causes losses approximating $200,000,000 yearly in the United States. One of the greatest needs in controlling these pests is an effective poison which they will take freely. The investigator who discovers this will do a great service not only to this country but to the world. Little exact knowledge is available as to the relation of rats to the spread of diseases of man other than bubonic plague.

It is also desirable and important to learn whether other native rodents than the California ground squirrel are susceptible to the plague and can transmit it. The ground squirrel named is known to be a plague carrier. In important practical questions, such as that of determining the disease-carrying rodents, a technical knowledge of the various species and their distribution becomes of prime importance.

Many of the government bureaus, including the Biological Survey in the Department of Agriculture, are now cooperating with agricultural colleges and certain activities in universities. Yet the great majority of people out of Washington do not generally appreciate the real extent and variety of investigational activity in the capital, not even men engaged in related lines of work. The spirit of cooperation, however, is growing. An instance of this is the awakening interest of state institutions in the investigation of the relation of rodents to the production of forage plants, crops and other vegetation. A representative of the Agricultural College of Arizona is actively cooperating with the Biological Survey in a project of that character begun last

year in southern Arizona. The Agricultural College of the University of California has worked out a plan for cooperation with this bureau in the study of the relations of rodents to forage production in that state. The Museum of Vertebrate Zoology of the University of California is continually cooperating with the Biological Survey in its technical research relating to birds and mammals. Other universities have been cooperating along certain lines, as in the case of the Universities of Michigan, Wisconsin and Stanford with the Bureau of Fisheries. In some institutions of learning work is being conducted along lines parallel to that of the Bureau of Biological Survey, but without any definite cooperation and in some cases apparently without any definite effort to keep informed as to current work being done in Washington.

The biological surveys of the states covering field studies of the species of birds and mammals and the most characteristic vegetation and their distribution in relation to temperature or life zones, which this bureau has been conducting for many years, have in some instances, as in the case of Oregon and Washington, had local cooperation from state institutions. The bureau will be glad to see much more of this active cooperation developed in the future. Then, whenever a state survey is being conducted, students of the local colleges may have an opportunity for doing field work in the study of birds, mammals and the distribution of plants, thus gaining an insight into the relationships which exist in nature and obtaining a practical knowledge of field methods which have resulted from years of experience. The Biological Survey welcomes cooperation and will be glad to make itself helpful to students and laboratory workers who desire information or suggestions which may be useful in developing their studies.

In the practical handling of economic zoological problems it is interesting to note the close dependence of one specialist on another. The Biological Survey is continually forced to seek aid of the specialists in the Bureau of Entomology, in the Bureau of Animal Husbandry, in the Bureau of Plant Industry, and even in the Bureau of Chemistry. This being the case, it is evident that the college student of narrow viewpoint will be at a disadvantage when getting into professional scientific work.

The foregoing facts touching the work of the Biological Survey are illustrative of the many opportunities for useful research open to the student of birds and mammals. These opportunities form only an exceedingly small fraction of the vast field covered by economic zoology and the necessary attendant technical studies.

In its relations to the public welfare economic zoology is of the most vital and far-reaching importance. Animal life, from its lowliest organisms, among which lurk some of our deadliest foes as well as beneficent friends, to the highest vertebrates, touches and affects our lives and welfare in innumerable ways. It must be studied in all its phases as never before to guard against previously unsuspected or little-known diseases of man and domestic animals, as well as to develop the wealth and ever-increasing variety of products from which we obtain food, medicines, clothing, dyes, ornaments and an endless number of other useful articles. No man can now be considered well informed who has not a general knowledge of economic zoology in its more direct relationships to human life. The scientific investigator finds in the subject the charm of endless variety and of service to mankind.

E. W. Nelson

THE HISTORY OF POISON GASES

The introduction of poison gases by the Germans at Ypres in April, 1915, marked a new era in modern warfare. The popular opinion is that this form of warfare was original with the Germans. Such, however, is not the case. Quoting from an article in the *Candid Quarterly Review,* (4–561), "All they can claim is the inhuman adoption of devices invented in England, and by England rejected as too horrible to be entertained even for use against an enemy." But the use of

poison gases is even of an earlier origin than this article claims.

The first recorded effort to overcome an enemy by the generation of poisonous and suffocating gases seems to have been in the wars of the Athenians and Spartans (431–404 B.C.) when, besieging the cities of Platea and Belium, the Spartans saturated wood with pitch and sulphur and burned it under the walls of these cities in the hope of choking the defenders and rendering the assault less difficult. Similar uses of poisonous gases are recorded during the Middle Ages. In effect they were like our modern stink balls, but were projected by squirts or in bottles after the manner of a hand grenade. The legend is told of Prester John (about the eleventh century), that he stuffed copper figures with explosives and combustible materials which, emitted from the mouths and nostrils of the effigies, played great havoc.

The idea referred to by the writer in the *Candid* is from the pen of the English Lord Dundonald, which appeared in the publication entitled "The Panmure Papers." This is an extremely dull record of an extremely dull person, only rendered interesting by the one portion, concerned with the use of poison gases, which, it is said, "should never have been published at all."

The great Admiral Lord Dundonald—perhaps the ablest sea captain ever known, not even excluding Lord Nelson—was also a man of wide observation, and no mean chemist. He had been struck in 1811 by the deadly character of the fumes of sulphur in Sicily; and, when the Crimean War was being waged, he communicated to the English government, then presided over by Lord Palmerston, a plan for the reduction of Sebastopol by sulphur fumes. The plan was imparted to Lord Panmure and Lord Palmerston, and the way in which it was received is so illustrative of the trickery and treachery of the politician that it is worth while to quote Lord Palmerston's private communication upon it to Lord Panmure:

LORD PALMERSTON TO LORD PANMURE

"HOUSE OF COMMONS, 7th August, 1855

"I agree with you that if Dundonald will go out himself to superintend and direct the execution of his scheme, we ought to accept his offer and try his plan. If it succeeds, it will, as you say, save a great number of English and French lives; if it fails *in his hands*, we shall be exempt from blame, and if we come in for a small share of the ridicule, we can bear it, and the greater part will fall on him. You had best, therefore, make arrangement with him without delay, and with as much secrecy as the nature of things will admit of."

Inasmuch as Lord Dundonald's plans have already been deliberately published by the two persons above named, there can be no harm in now republishing them. They will be found in the first volume of "The Panmure Papers" (pp. 340–342) and are as follows:

"(ENCLOSURE)

"BRIEF PRELIMINARY OBSERVATIONS

"It was observed when viewing the Sulphur Kilns, in July, 1811, that the fumes which escaped in the rude process of extracting the material, though first elevated by heat, soon fell to the ground, destroying all vegetation, and endangering animal life to a great distance, as it was asserted that an ordinance existed prohibiting persons from sleeping within the distance of three miles during the melting season.

"An application of these facts was immediately made to Military and Naval purposes, and after mature consideration, a Memorial was presented on the subject to His Royal Highness the Prince Regent on the 12th of April, 1812, who was graciously pleased to lay it before a Commission, consisting of Lord Keith, Lord Exmouth and General and Colonel Congreve (afterwards Sir William), by whom a favorable report having been given, His Royal Highness was pleased to order that secrecy should be maintained by all parties.

"(Signed) DUNDONALD

"7th August, 1855"

"MEMORANDUM

"Materials required for the expulsion of the Russians from Sebastopol: Experimental trials have shown that about five parts of coke effectually vaporize one part of sulphur. Mixtures for land service, where weight is of importance, may, however, probably be suggested by Professor Faraday, as to operations on shore I have paid little attention. Four or five hundred tons of sulphur and two thousand tons of coke would be sufficient.

"Besides these materials, it would be necessary to have, say, as much bituminous coal, and a couple

of thousand barrels of gas or other tar, for the purpose of masking fortifications to be attacked, or others that flank the assailing positions.

"A quantity of dry firewood, chips, shavings, straw, hay or other such combustible materials, would also be requisite quickly to kindle the fires, which ought to be kept in readiness for the first favourable and steady breeze.

"Dundonald

"7th August, 1855."

"*Note.*—The objects to be accomplished being specially stated the responsibility of their accomplishment ought to rest on those who direct their execution.

"Suppose that the Malakoff and Redan are the objects to be assailed it might be judicious merely to obscure the Redan (by the smoke of coal and tar kindled in 'The Quarries'), so that it could not annoy the Mamelon, where the sulphur fire would be placed to expel the garrison from the Malakoff, which ought to have all the cannon that can be turned towards its ramparts employed in overthrowing its undefended ramparts.

"There is no doubt but that the fumes will envelop all the defenses from the Malakoff to the Barracks, and even to the line of battleship, the Twelve Apostles, at anchor in the harbour.

"The two outer batteries, on each side of the Port, ought to be smoked, sulphured, and blown down by explosion vessels, and their destruction completed by a few ships of war anchored under cover of the smoke."

That was Lord Dundonald's plan in 1855, improperly published in 1908, and by the Germans, who thus learnt it, ruthlessly put into practise in 1915.

Lord Dundonald's memoranda, together with further elucidatory notes, were submitted by the English government of that day to a committee and subsequently to another committee in which Lord Playfair took leading part. These committees, with Lord Dundonald's plans fully and in detail before them, both reported that the plans were perfectly feasible; that the effects expected from them would undoubtedly be produced; but that those effects were so horrible that no honorable combatant could use the means required to produce them. The committee therefore recommended that the scheme should not be adopted; that Lord Dundonald's account of it should be destroyed. How the records were obtained and preserved by those who so improperly published them in 1908 we do not know. Presumably they were found among Lord Panmure's papers. Admiral Lord Dundonald himself was certainly no party to their publication.

Thus it will be seen that the plan which England had rejected as being too horrible for use in warfare has been, through the deplorable conduct of those who somehow obtained and published it, stolen from us by the Germans, and first used against us. That having been done, we cannot choose but retaliate in kind; for when such methods of warfare are used against us we must, for our own protection and that of our soldiers, ourselves use means similar and as efficacious. Such means lie ready to our hand in Admiral Lord Dundonald's plans; and it is to be presumed that they are now worked out and perhaps improved upon by the modern chemists so as to enable us effectually to give back to the Germans as good a gas as they send us.

One of the early, if not the earliest suggestion as to the use of poison gas in shell is found in an article of "Greek Fire," by B. W. Richardson.[1]

He says:

I feel it a duty to state openly and boldly, that if science were to be allowed her full swing, if society would really allow that "all is fair in war," war might be banished at once from the earth as a game which neither subject nor king dare play at. Globes that could distribute liquid fire could distribute also lethal agents, within the breath of which no man, however puissant, could stand and live. From the summit of Primrose Hill, a few hundred engineers, properly prepared, could render Regent's Park, in an incredibly short space of time, utterly uninhabitable; or could make an army of men, that should even fill that space, fall with their arms in their hands, prostrate and helpless as the host of Sennacherib.

The question is, shall these things be? I do not see that humanity should revolt, for would it not be better to destroy a host in Regent's Park by making the men fall as in a mystical sleep, than to let down on them another host to break their bones, tear their limbs asunder and gouge out their entrails with three-cornered pikes; leaving a vast majority undead, and writhing for hours in torments of the damned? I conceive, for one, that science would be blessed in spreading her wings on the blast, and breathing into the face of a desperate horde of men prolonged sleep—for it need not necessarily be a death—which they could not

[1] *Popular Science Review*, 3, 176, 1864.

grapple with, and which would yield them up with their implements of murder to an enemy that in the immensity of its power could afford to be merciful as Heaven.

The question is, shall these things be? I think they must be. By what compact can they be stopped? It were improbable that any congress of nations could agree on any code regulating means of destruction: but if it did, it were useless; for science becomes more powerful as she concentrates her forces in the hands of units, so that a nation could only act, by the absolute and individual assent of each of her representatives. Assume, then, that France shall lay war to England, and by superior force of men should place immense hosts, well armed, on English soil. Is it probable that the units would rest in peace and allow sheer brute force to win its way to empire? Or put English troops on French soil, and reverse the question?

To conclude. War has, at this moment, reached, in its details, such an extravagance of horror and cruelty, that it can not be made worse by any art, and can only be made more merciful by being rendered more terribly energetic. Who that had to die from a blow would not rather place his head under Nasmyth's hammer, than submit it to a drummer-boy armed with a ferrule?

The *Army and Navy Register* of May 29, 1915, reports that

among the recommendations forwarded to the Board of Ordnance and Fortifications there may be found many suggestions in favor of the asphyxiation process, mostly by the employment of gases contained in bombs to be thrown within the lines of the foe, with varying effects from peaceful slumber to instant death. One ingenious person suggested a bomb laden to its full capacity with snuff, which should be so evenly and thoroughly distributed that the enemy would be convulsed with sneezing, and in this period of paroxysm it would be possible to creep up on him and capture him in the throes of the convulsion.

That the use of poison gases was not new in the minds of military men follows logically from the fact that at the Hague Conference in 1899, the governments represented—and all the warring powers of the present great conflict were represented—pledged themselves not to use any projectiles whose only object was to give out suffocating or poisonous gases. At the Congress of 1907, article 23 of the rules adopted for war on land states:

It is expressly forbidden (*a*), to employ poisons or poisonous weapons.

Before the war suffocating cartridges were shot from the cartridge-throwing rifle of 26 mm. These cartridges were charged with ethyl bromoacetate, a slightly suffocating and non-toxic lachrymator. They were intended for attack on the flanking works of permanent fortifications, flanking casements or caponiers, into which they tried to make these cartridges penetrate by the narrow slits of the loopholes. The men who were serving the machine guns or the cannon of the flanking works would have been bothered by the vapor from the ethyl bromoacetate, and the assailant would have profited by their disturbance to get past the obstacle presented by the fortification. The employment of these devices, not entailing death, did not contravene the Hague conventions.

The only memorable operations in the course of which these devices were used before the war was the attack on the Bonnet gang at Choisy-le-roi.

In the war of the trenches there has been an abuse in the employment of these suffocating cartridges; an abuse because the small quantity of liquid that they contain, about 19 cubic centimeters, can produce no effect on a terrain without cover.

In connection with the suggested use of sulphur dioxide by Lord Dundonald and the proposed use of poisonous gases in shell, the following description of a charcoal respirator by Dr. J. Stanhouse,[2] communicated by Dr. George Wilson is of interest.

Dr. Wilson commenced by stating, that having read with much interest the account of Dr. Stenhouse's researches on the deodorizing and disinfecting properties of charcoal, and the application of these to the construction of a new and important kind of respirator, he had requested the accomplished chemist to send one of his instruments for exhibition to the society, which he had kindly done. Two of the instruments were now on the table, differing, however, so slightly in construction, that it would be sufficient to explain

[2] *Trans. Royal Scottish Soc. Arts,* 4, Appendix O, 198, 1854.

the arrangement of one of them. Externally, it had the appearance of a small fencing-mask of wire gauze, covering the face from the chin upwards to the bridge of the nose, but leaving the eyes and forehead free. It consisted, essentially, of two plates of wire gauze, separated from each other by a space of about one fourth or one eighth of an inch, so as to form a small cage filled with small fragments of charcoal. The frame of the cage was of copper, but the edges were made of soft lead, and were lined with velvet, so as to admit of their being made to fit the cheeks tightly and inclose the mouth and nostrils. By this arrangement, no air could enter the lungs without passing through the wire gauze and traversing the charcoal. An aperture is provided with a screw or sliding valve for the removal and replenishment of the contents of the cage, which consist of the siftings or riddlings of the lighter kinds of wood charcoal. The apparatus is attached to the face by an elastic band passing over the crown of the head and strings tying behind, as in the case of the ordinary respirator. The important agent in this instrument is the charcoal, which has so remarkable a power of absorbing and destroying irritating and otherwise irrespirable and poisonous gases or vapors that, armed with the respirator, spirits of hartshorn, sulphuretted hydrogen, hydrosulphuret of ammonia and chlorine may be breathed through it with impunity, though but slightly diluted with air. This result, first obtained by Dr. Stenhouse, has been verified by those who have repeated the trial, among others by Dr. Wilson, who has tried the vapors named above on himself and four of his pupils, who have breathed them with impunity. The explanation of this remarkable property of charcoal is two-fold. It has long been known to possess the power of condensing into its pores gases and vapors, so that if freshly prepared and exposed to these, it absorbs and retains them. But it has scarcely been suspected till recently, when Dr. Stenhouse pointed out the fact, that if charcoal be allowed to absorb simultaneously such gases as sulphuretted hydrogen and air, the oxygen of this absorbed and condensed air rapidly oxidizes and destroys the accompanying gas. So marked is this action, that if dead animals be imbedded in a layer of charcoal a few inches deep, instead of being prevented from decaying as it has hitherto been supposed that they would be by the supposed antiseptic powers of the charcoal, they are found by Dr. Stenhouse to decay much faster, whilst at the same time, no offensive effluvia are evolved. The deodorizing powers of charcoal are thus established in a way they never have been before; but at the same time it is shown that the addition of charcoal to sewage refuse lessens its agricultural value contemporaneously with the lessening of odor. From these observations, which have been fully verified, it appears that by strewing charcoal coarsely powdered to the extent of a few inches, over church-yards, or by placing it inside the coffins of the dead, the escape of noisome and poisonous exhalations may be totally prevented. The charcoal respirator embodies this important discovery. It is certain that many of the miasma, malaria and infectious matters which propagate disease in the human subjects, enter the body by the lungs, and impregnating the blood there, are carried with it throughout the entire body, which they thus poison. These miasma are either gases and vapors or bodies which, like fine light dust, are readily carried through the air; moreover, they are readily destroyed by oxidizing agents, which convert them into harmless, or at least non-poisonous substances, such as water, carbonic acid and nitrogen. There is every reason, therefore, for believing that charcoal will oxidize and destroy such miasma as effectually as it does sulphuretted hydrogen or hydrosulphuret of ammonia, and thus prevent their reaching and poisoning the blood. The intention accordingly is that those who are exposed to noxious vapors, or compelled to breathe infected atmospheres, shall wear the charcoal respirator, with a view to arrest and destroy the volatile poisons contained in these. Some of the non-obvious applications of the respirator were then referred to:

1. Certain of the large chemical manufacturers in London are now supplying their workmen with the charcoal respirators as a protection against the more irritating vapors to which they are exposed.

2. Many deaths have occurred among those employed to explore the large drains and sewers of London from exposure to sulphuretted hydrogen, etc. It may be asserted with confidence that fatal results from exposure to the drainage gases will cease as soon as the respirator is brought into use.

3. In districts such as the Campagna of Rome, where malaria prevails and to travel during night or to sleep in which is certainly followed by an attack of dangerous and often fatal ague, the wearing of the respirator even for a few hours may be expected to render the marsh poison harmless.

4. Those, who as clergymen, physicians or legal advisers, have to attend the sick-beds of sufferers from infectious disorders, may, on occasion, avail themselves of the protection afforded by Dr. Stenhouse's instrument during their intercourse with the sick.

5. The longing for a short and decisive war has led to the invention of "a suffocating bombshell," which on bursting, spreads far and wide an irrespirable or poisonous vapor; one of the liquids proposed for the shell is the strongest ammonia, and against this it is believed that the charcoal respirator may defend our soldiers. As likely to serve this end, it is at present before the Board of Ordnance.

Dr. Wilson stated, in conclusion, that Dr. Stenhouse had no interest but a scientific one in the success of the respirators. He had declined to patent them, and desired only to apply his remarkable discoveries to the abatement of disease and death. Charcoal had long been used in filters to render poisonous water wholesome; it was now to be employed to filter poisonous air.

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DUTY FREE SUPPLIES

The interest in duty-free material has changed to some extent since 1914 because of the impossibility since that time of importing materials from the Central Powers, the former source of supply. During the war some American firms have turned elsewhere, because our European Allies were not in a position to meet the demand.

When the duty-free law was passed, provision was made for the importation without tariff of materials for educational institutions and those engaged in scientific research. The purpose of this law, of course, was to give these institutions the advantage of anything that was made in foreign countries and thus American scientists and the country as a whole were enabled to receive the benefit of foreign endeavor as far as possible. This was a means of promoting knowledge and in the early days of scientific production was certainly of great benefit to this country, but it also had ill effects as by-products. Scientific materials were used in large quantities and though there was demand enough, it was difficult for a business to succeed in this country where labor is paid at a higher schedule than abroad. Consequently, many lines of supplies which were used in considerable quantities were almost exclusively imported from foreign countries. Of course, it is true that these supplies, from a financial standpoint, were of very little importance as far as the country at large is concerned, because the values concerned amount to only a few million dollars annually.

But it must be recognized that we learn to make things by actual experience, and if one produces scientific apparatus and produces it in an efficient and satisfactory manner, he is able consequently to produce a related thing for which there might be a critical need. For instance: when the war broke out and the importations from the Central Powers ceased, this country found itself almost entirely without optical glass. The optical glass used in scientific institutions had been imported and everything went along quite normally in peace times but with the outbreak of the war optical glass became a vital necessity, for one might say there is no instrument of defense which is not connected in some way with optical glass, ranging all the way from telescopes and field-glasses to eyeglasses. The country that can not produce such things satisfactorily and cheaply in an emergency is certainly greatly handicapped in providing defense. We all know of the consternation caused in this country in April, 1917, as the seriousness of the situation dawned upon the government and the public, when it was discovered that no optical glass, broadly speaking, was available for war work, the supply of foreign glass having been exhausted. Perhaps in a minor way this same state of affairs occurred in almost every other industry of scientific nature in this country. One need only consider the difficulty in securing such instruments as polariscopes and microscopes to realize the scarcity that is bound to exist where any one country is dependent upon another for absolutely necessary supplies.

Therefore it is certainly true that the na-

tional welfare requires that the manufacturer of scientific apparatus in this country should be sufficiently protected so as to be enabled to compete with foreign production. But, on the other hand, it is evident that if we make the duty on such supplies so rigid as to exclude foreign articles entirely, a decided handicap on knowledge must result, for it is well understood by those who have been in touch with scientific production that certain things, such as fine instruments and rare chemicals, can only be profitably made by one concern, perhaps, in the whole world. It does not pay any one else to compete with such a manufacturer as the sales are too small. If, for instance, there is need of some rare organic chemical that is only made by one man in the world and, while of very great scientific value, is not sufficiently used to warrant any two concerns to study the details of manufacture, it is obviously unwise to handicap any scientist in any country from obtaining this article. Many of the chemicals in Kahlbaum's list, so familiar to all in pre-war days, come in this category, and it can not be disputed that a prohibitive duty on such items will restrict research work to a considerable extent and serve no good purpose, because the amount of revenue received by the government is too small. In addition, the encouragement given to manufacturers to produce rare chemicals is almost nil and no American firm could be induced to undertake the task. Perhaps in the past the duty-free privilege to institutions was abused, not directly by the institutions, but because of the wording of the original law, for some articles which had acquired a commercial rather than a scientific standing could be imported duty-free by all institutions regardless of the fact whether the article was also produced in this country or not. The patriotic element played no part in the decision, even though the home-made article cost but little more than the imported one.

One great drawback to the importation of scientific apparatus has always been the great amount of time which elapses between placing the order and its delivery. In order to overcome this drawback many people, and this ingeniously, have sought to induce the importer to deliver the goods from the shelves and replace the article when the import shipment arrives. However, this was a distinct evasion of the law and it has been reported that certain firms have been threatened with fines for committing this evasion of the government regulations. In some cases these firms did this unknowingly for the accommodation of the institution. Again, in many cases the interest in the research had almost vanished before the article was delivered. Therefore, to meet the demand, firms that imported materials were compelled to carry immense stocks of imported articles in order that they might have on hand the kind of apparatus or the chemical required. This necessitated an enormous increase in the cost of apparatus to institutions. Furthermore, any improvements to apparatus which might occur to the scientist after having placed the order were impossible of execution, owing to the distance between the manufacturer and the user. It might be said that the distance between manufacturer and consumer has almost always prevented the habit of suggesting improvements from making itself felt. This difficulty could be avoided by having the apparatus manufactured nearer at hand.

The law proposed by the Council of the American Chemical Society, namely, that the duty-free law be entirely abolished, will undoubtedly prove satisfactory to a limited extent.[1] Apparently there is no great opposition to the law on the part of institutions that have been accustomed to duty-free importation and naturally no commercial firm that has made use of duty-paid materials before will oppose it.

As a matter of fact, many American firms make materials that are equal if not superior in many ways to the imported goods. Coors porcelain, made by the Herold Glass & Porcelain Company of Golden, Colorado, Pyrex Glass of the Corning Glass Company of Corn-

[1] See *Journal of the American Chemical Society*, January, 1919, Council Proceedings and *Journal of Industrial and Engineering Chemistry*, January, 1919.

ing, New York, the Nonsol Glass manufactured by Whitall, Tatum & Company at Milville, New Jersey, the especially fine physical control of the Kimble Glass Company at Vineland, New Jersey, and the production of fine special apparatus by Eimer & Amend of New York City—all show what can be done in this country in an emergency. If these conditions continue to be fostered we may in time lead the world in the production of scientific things. Certainly interest in this subject is growing and a movement is now on foot to interest manufacturers, jobbers and buyers in the possible publication of a journal devoted to chemical apparatus.

Undoubtedly the time will come, however, when some qualifying clause should be embodied in the tariff laws by which the defects of the proposed high protective tariff laws will be overcome, in order to assist especially qualified men to procure from abroad articles of great scientific merit though of little commercial value, which of necessity must be produced by the genius who devised the apparatus or prepared the compound. Probably this clause would necessarily be administered by some committee of scientists appointed by the government. Whether these defects to the proposed law are to be remedied by allowing certain things to come in duty-free as indicated, or by a system of bonuses to scientific institutions or members using material, is a debatable question.

To sum up the whole matter, it would seem to the authors that a method should be devised whereby all essential scientific material should be manufactured by the nation and while a general protective duty will probably be secured from Congress, it is our opinion that care should be taken that no obstacle be put in the way of the scientist doing constructive research.

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SCIENTIFIC EVENTS

THE USE OF REINFORCED CONCRETE IN SHIPBUILDING

Reinforced concrete was first used in making a boat in France in 1849, but its use languished from 1849 until 1887 when a small concrete boat was built in Holland. This boat was first used by duck shooters on account of its high stability, and in 1918 it was still in use by a cement-products company in Amsterdam. Italy, Germany and England next fell in line, and a revival of concrete boat construction in France took place in 1916. Concrete boats were constructed also in New South Wales, Canada, China and Spain. After the outbreak of the war, as her ships were destroyed by submarines, Norway lost no time in building concrete ships. At the Fougner plant, at Moss, the Nannsiffiord, a 200-ton concrete cargo vessel was built and, after a successful trial trip, engaged in traffic between Norway and England and along the Norwegian coast. This was practically the pioneer seagoing self-propelled concrete ship.

In 1918 the construction of two fleets of concrete barges, each barge measuring 20 by 130 feet and of 550 tons capacity, was begun at New Orleans, La., and at Seattle, Wash. In 1918 the *Faith,* a concrete self-propelled merchant vessel of 5,000 tons dead-weight capacity, was launched at San Francisco, Cal.

In the stress to supply new ships reinforced concrete was adopted as a building material mainly for the following reasons: First, the concrete materials required are easily obtained, and the steel needed is employed in a form and quantity which make no strain on the rolling mills; second, the labor is less skilled and is recruited from a class totally different from the ordinary shipyard labor, so that the work does not increase the stress on the existing shipyards; third, a concrete ship costs no more than a steel ship and requires less expenditure for its upkeep; fourth, the time of construction is shorter.

When these facts are coupled with three considerations which make reinforced concrete most valuable for shipbuilding there seem to

be abundant reasons for its present larger use for that purpose. These considerations are: First, the concrete ship can be made practically waterproof; second, the reinforcement can be completely inclosed by the concrete so as to prevent rusting; third, concrete and reinforced concrete are absolutely fireproof.

Concrete used as construction material improves with age; there is no definite knowledge to-day as to the limits of its durability in time. It is not known to be attacked by insects; mould, vermin and bacteria find no soil for growth in it, and consequently ferroconcrete vessels can easily be kept clean. The ease of repairing a concrete ship by the simple application of new concrete is also a distinct advantage.

A chapter of "Mineral Resources of the United States" on cement in 1917, published by the United States Geological Survey, Department of the Interior, includes a section on concrete ships, by Robert W. Lesley, associate of the American Society of Civil Engineers, one of the pioneer manufacturers of Portland cement and a member of the committee on concrete ships of the American Concrete Institute. Mr. Lesley gives a full account of the ship *Faith,* the investigations of the American Concrete Institute, government construction, and patents for concrete ships, also a bibliography of concrete in shipbuilding.

In carrying out its emergency shipbuilding program the government made contracts for a large number of concrete ships. After the armistice the general program was changed; the total output of steel, wood and concrete ships was curtailed, but the infant concrete shipbuilding industry will probably continue to grow, for it still affords great opportunities for research and development.

EDUCATION AND SCIENCE IN THE BRITISH CIVIL SERVICE ESTIMATES

THE estimates for civil services for the year ending March 31, 1920, as quoted in *Nature,* amounted in Class IV. (Education, Science and Art), to £41,251,610. The following are among the estimates:

United Kingdom and England

Service	Compared with 1918–19	1919–20 £
Board of Education	31,353,111	12,243,406
British Museum	209,714	83,572
Scientific investigation, etc.	113,974	59,733
Department of Scientific and Industrial Research	242,815	94,465
Universities and Colleges, United Kingdom, and Intermediate Education, Wales	945,700	624,000
Universities, etc., special grants	500,000	470,000
Scotland		
Public education	4,677,220	1,635,675
Ireland		
Public education	2,721,356	519,752
Intermediate education	90,000	—
Science and art	190,498	27,105
		Decrease
Universities and colleges	85,000	11,350

Details of some of these estimates of particular interest to men of science are as follows:

SCIENTIFIC INVESTIGATIONS, ETC.

	£
Royal Society:	
(i) Grant in aid of (*a*) scientific investigations undertaken with the sanction of a committee appointed for the purpose (£4,000) and (*b*) scientific publications (£1,000)	5,000
(ii) Grant in aid of salaries and other expenses of the Magnetic Observatory at Eskdalemuir	1,000
Meteorological Office	47,000
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	1,000
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Zoological Society of Ireland	500
British School at Athens	500
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	8,900
National Museum of Wales:	
Grant in aid of the expenses of the museum	4,000
Special building grant in aid	20,000
Solar Physics Observatory	3,000
School of Oriental Studies	4,000

North Sea Fisheries Investigation	1,250
Imperial Mineral Resources Bureau	11,000
Edinburgh Observatory	1,974

SCIENTIFIC AND INDUSTRIAL RESEARCH	£
Salaries, wages and allowances	11,870
Traveling and incidental expenses	1,500
Grants for Investigation and Research:	
(1) Grants for investigations carried out by learned and scientific societies, etc.	13,570
(2) Grants for investigations directly controlled by the Department of Scientific and Industrial Research	55,000
(3) Grants to students and other persons engaged in research	25,000
Fuel Research Station	12,775
National Physical Laboratory	154,650

SCIENTIFIC NOTES AND NEWS

The American Philosophical Society will procure a portrait of the late Edward C. Pickering to be hung in the hall of the society "as a token of the affectionate regard in which he was held by his fellow members." Professor Pickering was a vice-president of the society from 1909 to 1917.

Dr. J. A. Allen, curator of mammals in the American Museum of Natural History, New York City, has been elected the first honorary member of the American Society of Mammalogists and the only person to be elected to such membership during the present year.

The Harris lectures for 1920 at Northwestern University, are to be delivered by Professor Edward Sharpley Schafer, professor of physiology in the University of Edinburgh.

Dr. E. H. Sellards, who has been state geologist of Florida since the organization of the survey in 1907, has resigned, and has accepted appointment as geologist in the Bureau of Economic Geology of the University of Texas. Herman Gunter who has been assistant geologist since the department was established has been appointed state geologist.

Dr. Herman Biggs, public health commissioner, New York state, presided over the Red Cross Conference held at Cannes this month.

Consequent upon the occupation of Alsace-Lorraine by the French, M. Esclangon, formerly assistant at the Bordeaux Observatory, has been appointed director of the Strasbourg Observatory.

W. M. Smart, M.A., Trinity College, Cambridge, has been appointed chief assistant at the Cambridge Observatory.

Professor Vaughan Harley has resigned the chair of pathological chemistry, which he has held for twenty-three years at the University of London.

Concluding a study of the various phases of the food problem in Army aviation camps, Guy R. Stewart, assistant professor of agricultural chemistry, has resumed his duties at the University of California. Dr. Roy E. Clausen, assistant professor of genetics, has also returned to the university after nearly two years' service in the army.

The following members of Stanford University have been released from government service and resumed their academic duties with the opening of the spring quarter, March 31, 1919: Bailey Willis, professor of geology; William Frederick Durand, professor of mechanical engineering; Ernest Gale Martin, professor of physiology; Clelia Duel Mosher, assistant professor of personal hygiene and medical adviser of women; Albion Walter Hewlett, professor of medicine and Stanley Stillman, professor of surgery.

A complimentary dinner was tendered Colonel Alexander Lambert, M. C., U. S. Army, president-elect of the American Medical Association, by his professional friends in New York City, on April 12. About 400 of the leading physicians of New York and the east attended. Dr. George D. Stewart acted as toastmaster. The speakers were Colonel Frank Billings, M. C., U. S. Army, Chicago; Dr. William S. Thayer, of Baltimore; Dr. George E. Brewer, of New York, and Rev. Charles A. Eaton, of New York. Dr. Lambert responded with an account of his experiences abroad as chief medical director of the American Red Cross hospitals.

The *Journal of the American Mathematical Society* states that Professor Joseph Allen, of the College of the City of New York, and Professor W. H. Metzler, of the University of Syracuse, have gone to France on army educational work. Captain P. L. Thorne, assistant professor of mathematics at New York University, has recently returned to his university work. He served at the front in France with the Sixtieth Heavy Artillery regiment. Captain A. L. Underhill, of the University of Minnesota, has been appointed Commandant at the University of Grenoble in France, where several hundred American soldiers are taking courses while awaiting their opportunity to return home.

Professor Miyajima, of Tokyo, has arrived in Brazil where he is to do pathological research work at the Butantan Institute.

Messrs. Hoyt S. Gale and J. B. Umpleby, of the U. S. Geological Survey, have gone to France to investigate certain questions of mineral resources, particularly potash salts, involved in the peace negotiations.

UNIVERSITY AND EDUCATIONAL NEWS

The New Haven Section of the American Chemical Society will give a scholarship in chemistry in the Yale Graduate School for the year 1919–20, with the understanding that the scholarship be given to "a graduate student who is a candidate for a higher degree in the department of chemistry. The recipient must be a resident of the territory covered by the New Haven Section, and be selected by a committee composed of the president and councillor of the section and the chairman of the department of chemistry of Yale University."

The Iowa state legislature has appropriated $175,000 for the establishment of a psychopathic hospital at the state university. This hospital will be open to both public and private patients suffering from mental disorders. The same legislature also extended the so-called Perkins law to include adults. By the Perkins law an orthopedic hospital is maintained at the university for the free treatment of the crippled children in the state.

Assistant Professor Leo F. Rettger has been promoted to a professorship of bacteriology at Yale University. Dr. Rettger received his B.A. and M.A. at the University of Indiana, and his Ph.D. from Yale in 1902. After studying abroad he was for five years research scholar and fellow at the Rockefeller Institute for Medical Research.

In the department of chemistry of the Massachusetts Institute of Technology the following appointments have been made: William H. McAdams, to be assistant professor of chemical engineering; Dr. Charles S. Venable and Dr. William G. Horsch, to be research associates in applied chemistry, and Thomas M. Knowland, to be research assistant in the same department.

At the University of Strasbourg, professor René M. Fréchet, of the university of Poitiers, has been appointed professor of mathematics, and Pierre Weiss, professor at the Polytechnikum, Zurich, professor of general physics.

Professor E. Wiechert, of Göttingen, has been appointed professor of geodesy and geophysics at the University of Berlin.

The Cavendish professorship of experimental physics, at the University of Cambridge, recently vacated by Sir J. J. Thomson, has been filled by the appointment of Sir Ernest Rutherford, of the University of Manchester. Sir J. J. Thomson retains an honorary professorship.

DISCUSSION AND CORRESPONDENCE

ERRONEOUS GENERIC DETERMINATIONS OF BEES

In Science, 49: 71, Professor Stevens makes some statements regarding a paper with the above title in Science, 48: 368. He thinks many important factors influencing generic limitations were overlooked. For example, he points out that the average varies in proportion to the size of the region. In comparing the New Jersey with the local list I thought that fact was obvious. It was intended to discuss neither various factors nor

particular cases, but only to mention an impersonal criterion for showing that the generic determinations of bees in the lists cited were erroneous.

At first he takes the second of my alternatives and holds that the bees differ from all of the other groups of insects, and even among plants are only comparable with the Poales. Then he changes about, makes the erroneous assumption that the bees and Lower Aculeata were more completely represented in the local list, and arrives at the mistaken conclusion that such a condition would explain the discrepancy between the averages of these insects and the others.

Stevens compares *Andrena* with *Carex*. The so-called genus *Andrena* reminds one of the time when all of the owls were referred to *Strix*. It would not seem so large if the sexes were not described as distinct species. In a recent paper only 4.6 per cent. of the so-called species were described from both sexes. If one is so careless of his entomology and diction as to say species when he means sex, what is to keep him from saying subgenus or quidnunc-group instead of genus? One who ignores the fact that bees have two sexes is not competent to distinguish any genera except those based on characters common to both sexes. If you should disregard the secondary sexual characters and the habits of the females, how well could you understand the classification of the Hymenoptera in general.

Small divides *Carex* into two subgenera and 34 what-d'ye-call-'ems—named groups with subfamily, family, ordinal and other endings. One might like to know what categories the organisms form, not how they are to be forced to fit preconceived categories. The genus seems to be regarded with superstitious reverence when it contains 34 groups of the second order. Even the analogy of the Poales is against the bees. In the Fargo flora the Poales stand 2.3 against a general average of 1.8, while in the Carlinville list the bees stand 6. 5 against an average of 1.7.

Compared with the general average the bees and Lower Aculeata show a great discrepancy in both lists without regard to their percentages in the composition of them. The Coleoptera, respectively 33.7 and 10.6 per cent., approach the average in each list. In the local list the Coleoptera are quite fragmentary compared with the Diptera, but the average is about the same. The list of Rhopalocera, which is as complete as that of the bees, shows an average of 1.4 to the bees 6.5, while the Heterocera, which are quite fragmentary, average 1.2. The Bombyliidæ, Conopidæ, Syrphidæ, Tachinidæ and Muscidæ, in which the local list is quite complete, show 1.7 while the other Diptera average 1.6. The 437 local entomophilous flowers on which insect visitors were taken average 1.6 while the 520 plants of the Fargo flora average 1.8.

Although Stevens argues against small groups he says that he believes in the recognition of them, but he doubts the necessity of forcing them upon every one. The statement that neglected groups will be subdivided about like those which have been more thoroughly studied hardly involves an attempt to force small groups upon any one. You may say that a river runs south without trying to force the water on those who live down stream.

CHARLES ROBERTSON
CARLINVILLE, ILLINOIS

GEOMORPHOLOGY

TO THE EDITOR OF SCIENCE: The letter from Professor John L. Rich in your issue of January 11, 1918, escaped my notice at the time and my attention was not drawn to it until very recently. Hence this belated reply.

I agree thoroughly with Professor Rich that geomorphology has an interpretative geological value, and I admit that, for the sake of economy of space, it may be necessary sometimes to compress the geographical aspect of a geomorphological description and its geological interpretation into a single paper from which the geographer and the geologist will each attempt to pick out the points that interest him. The introduction of certain geological dates into a paper with such a double purpose is excusable, but it is the thin end of a wedge which may lead to much obscurity.

The artifice of placing geological names in

footnotes, where they do not break the continuity of the descriptive text, and of adding further geological information in an appendix is useful in drawing attention to the geological value of an interpretation of the physiography in a paper written primarily to explain and describe the land forms. This method I adopted in "The Physiography of the Middle Clarence Valley, New Zealand."[1]

In the case of my paper "Block Mountains in New Zealand," to which Professor Rich refers, the age of the covering strata in Central Otago is uncertain within fairly wide limits. The statement that they are probably Oamaruian but possibly Wanganuian would not convey much definite information to American readers. When I was preparing the paper for publication the temptation to discuss the age question was strong, and I yielded to it. Realizing that the discussion would be out of place in the body of the paper I placed it in an appendix, which, however, the editor wisely omitted.

This article was not written with a dual purpose. The geological significance of the land forms of Central Otago, as well as the closely related forms throughout New Zealand had already received full attention in a paper entitled "The Structure and Later Geological History of New Zealand," published in the *Geological Magazine*.[2] This and "Block Mountains in New Zealand" were in preparation at the same time, the one frankly geological, the other geographical. As such the latter was intended for publication in a geographical periodical and was offered to the Royal Geographical Society, which was unable, however, to find space for it in its *Journal*.

C. A. Cotton

Victoria University College,
Wellington, N. Z.

[1] Geog. Jour., vol. 42, 1913, pp. 225–46.

[2] December 6, vol. 3, 1916, pp. 243–249, 314–320.

"A WAVE OF LIFE"

An interrelation of organisms somewhat suggestive of Hudson's "wave of life" was observable about the University of Montana Biological Station on Flathead Lake the past season.

During the summer of 1917 flowers bloomed luxuriantly about the station grounds, and humming-birds and butterflies visited the flowers very commonly. Rodents were present in normal numbers, but attracted no particular attention.

Conditions were markedly changed during the summer of 1918. For unknown reasons the rodents became very abundant. Pine squirrels and chipmunks were everywhere present. Spermophiles appeared on the station grounds for the first time in the history of the institution. The chipmunks quickly cleared the ground of flowers and ascended to the tops of trees to strip the honeysuckle vines of their blossoms. Deprived of their natural food in this vicinity humming-birds were rarely seen and butterflies were very uncommon. Pine squirrels kept the ground under the pine trees well strewn with pine cones, but the effect of this inroad upon the pine cones was not so apparent upon other forms of life.

Weasels, which were not observed about the station the preceding summer, were seen several times during 1918. Great horned owls hooted at night in the nearby tree tops. These birds had not been reported for 1917.

G. B. Claycomb

University of Illinois

QUOTATIONS

THE PHYSIOLOGY OF A WORKING DAY

Gradual reduction of the hours of labor from ten or nine to eight, and now to seven or six, must have made many people wonder whether some scientific basis might not be found for the hours which should be worked in various trades. Major A. C. Farquharson raised the matter in the discussion on the second reading of the Ministry of Health Bill. Speaking as one who had spent the greater part of his professional life in the service of the miner, he expressed his astonishment that members of the House of Commons should be so ready to put forward the idea that the number of hours a man should work day by day was to be settled by the arbitrary

capricious decision of the mass. He contended that it was a scientific problem, and suggested that if science could establish that a normal man could work up to a given standard without detriment to his physical condition and without injury to his health or chance of longevity, the number of hours of a working day could be standardized. In the discussion on the bill in committee he contended that there ought to be a scientific department, working in relation with the Ministry of Health, to decide various matters of a physiological nature in relation to capital and labor, including suitable hours of work. We may point out that a large amount of scientific work had been done in this direction, some of which is summarized in the reports of the Health of Munition Workers Committee, but the subject is complex and physiology is far from having found a complete solution. It is comparatively easy to estimate the amount of energy given out in various kinds of work at various paces, but muscle fatigue is only one and probably the least important element in fatigue. There is in addition the mental element, which can not be measured, and the nervous element, which it will be possible to measure with difficulty if at all. Nervous fatigue occurs in the initiating and distributing nervous mechanisms of the brain and spinal cord, which are more quickly fatigued than the contracting muscles; consequently in the animal body the impulses to activity, springing from the brain, can not bring the muscles far towards complete fatigue before their sources are themselves fatigued and impotent. Though a tired man may refer his tiredness to the muscles, in reality the most severe bodily activity does not produce any close approach to complete fatigue of the muscles. The fatigue is of the nervous system, though its effects may be referred to the muscles. The conclusion of the committee was that the problems of industrial fatigue were primarily, and probably almost wholly, problems of fatigue in the nervous system and of its direct and indirect effects. Another complicating matter is that the human body seems to be adapted to withstand short spells of severe labor, broken by longer spells of rest; the point is illustrated by the story of a wager between two officers at the front as to the time to be taken in making equal lengths of a trench, each with an equal squad of men. One officer let his men work as they pleased, but as hard as possible. The other divided his men into three sets, to work in rotation, each set digging their hardest for five minutes and then resting for ten. The second team won easily. Another conclusion—this time in a report by Dr. H. M. Vernon to the same committee—was that the hours of labor ought to be varied between wide limits according to the character of the work performed. This seems the most promising line of inquiry.—*British Medical Journal.*

SCIENTIFIC BOOKS

Injurious Insects and Useful Birds. By F. L. Washburn, M.A. Philadelphia, J. B. Lippincott Co. Pp. xviii + 453. Price $1.75.

This little book is one of a series called "Lippincott's Farm Manuals" edited by Dr. K. C. Davis, and now containing about a dozen hand-books on as many phases of agricultural practise. The author of this volume, Professor Washburn, has for many years held the positions of state entomologist of Minnesota, professor of entomology, University of Minnesota and entomologist of the Agricultural Experiment Station, consequently as an investigator and teacher he is in possession of some first-hand knowledge and is posted regarding the work of others. A list of questions at the end of each chapter shows the custom of the teacher.

The book is divided into twenty-one chapters, with headings as follows: Loss to Agriculture Due to Insects and Rodents; Farm Practises to Lessen Insect and Rodent Injuries; External Structure of Insects, Orders. Metamorphosis; Collecting and Preserving Insects; Insectides and Spraying; Fumigation; Insects Injurious to the Apple; Insects Affecting the Pear and Quince; Plum, Peach and Cherry Insects; Insect Pests of Berries and Grapes; Principal Insects affecting Citrus

Fruits; Insects affecting Field Crops and Pasturage; Insects affecting Truck Crops and the Vegetable Garden; Insect Enemies of Greenhouse and House Plants and of the Flower Garden; Insects affecting Shade Trees; Insects affecting Man and the Household; Insects and Insect-like Animals attacking Stock and Poultry; Mill and Elevator Insects and Mill Fumigation; Our Insect Friends; The Relations of Birds to Agriculture; Some four-footed pests of the Farm.

There are four colored plates, and 414 illustrations in the text, many of the figures are from original photographs and drawings. and the others are borrowed from various sources, due credit being given.

This little volume differs from most other manuals of injurious insects in that considerable information regarding common birds and rodents may be found in the same book. Of course where so many species are treated within the limits of a small-sized volume, the account of each must necessarily be very brief. Probably the value of the work would have been enhanced by giving after each one or two references where the reader could obtain more complete information.

Nevertheless the author has condensed a large amount of information in this small volume which is well printed and supplied with index. It will prove a convenient manual for all growers of plants and keepers of live stock.

W. E. Britton

Agricultural Experiment Station,
New Haven, Conn.

ANTHROPOLOGICAL RESEARCH[1]

At the meeting of the American Anthropological Association held in Baltimore, December 27, Professor J. C. Merriam, representing the National Research Council, made a formal statement of the plans of the council in regard to the organization of science, and requested an expression of opinion on the part of the American Anthropological Association in regard to the position of anthropology in the work of the National Research Council.

In consequence of this request and the discussion following it, the undersigned committee was appointed for the purpose of giving to the National Research Council information in regard to the work actually done by American anthropologists. A statement has been added pointing out the causes for the slow development of certain branches of anthropology.

The committee has submitted a number of questions to American anthropologists and attached to this are a number of replies to our circular letter.

The general tendency of the scientific work of American anthropologists may briefly be summarized as follows: It is but natural that in a country like our own, which contains the remains of a considerable number of primitive people, the historical interest in the aborigines, combined with the ease of accessibility of the remainder of the ancient tribes, should bring it about that inquiries relating to their customs, languages and physical types should dominate American anthropological research, and that theoretical work should be based very largely upon the results obtained from a study of American tribes. The methods which give the easiest results in regard to these problems are archeological, ethnographical and linguistic, and for this reason these three lines of inquiry have hitherto predominated in the research work of American anthropologists.

At the same time the necessity for a broader outlook is keenly felt. The Field Museum of Natural History has included in the scope of its work Eastern Asia, Malaysia and Melanesia. Harvard University has expanded its work over Africa. The University of Pennsylvania has undertaken research work in South America, the American Museum of Natural History and the United States National Museum, in Asia, and a few other attempts of similar kind for obtaining a wider basis for research in cultural history may be noted.

[1] Report of the Committee of the American Anthropological Association to Professor G. E. Hale, chairman of the National Research Council, Washington, D. C.

The field of work of American anthropologists is also in part determined by the character of the institutions that maintain anthropological work. The Bureau of American Ethnology which forms part of the Smithsonian Institution is by law restricted to work on the natives of America and the Hawaiian Islands. Most positions held by working anthropologists are museum positions, and consequently the scientific work is largely restricted to those aspects of anthropology that yield tangible specimens. University positions are on the whole of such a character that the funds necessary for the conduct of field work are not supplied by the universities, but if available at all, come from museums.

Anthropologists have felt for a long time that their work needs expansion, and many attempts have been made to free anthropological research from the restrictions dependent upon the association of anthropological work with museums on the one hand, and from those conditions that tend to give undue preponderance to work on American Indians on the other hand. Attempts have been made particularly to direct attention to African problems, which are of importance to us on account of our large negro population, and also to investigations on racial anthropology among the white and negro populations of the United States. Work of this kind needs financial support, but all attempts have failed to interest the government institutions which command considerable funds, or private individuals, to support work of this type. There is a peculiar hesitancy in regard to undertakings of this kind, which will not be overcome until more work on a smaller scale has been done. Investigations of this description have been undertaken by American anthropologists and by educators, sociologists and medical men with anthropological leanings.

Recently, biologists have also directed their attention to this subject, but methods applied and results obtained up to this time are quite unsatisfactory. Work on human paleontology is also not vigorously pursued.

The difficulty of giving anthropological research an adequate position in the scheme of the National Research Council is largely based on the fact that the humanities find no place in the general scheme of work of the Research Council. While anthropology must necessarily be based on the one hand on biological science, on the other hand it is intimately associated with the humanities. It is impossible to treat even the biological problems of anthropology without a due regard to the cultural aspect of anthropology, because the forces which determine the development of human types are to a very large extent cultural forces.

The peculiar position of anthropology brings about close contact with a great many different sciences—biology, geology, paleontology, geography, psychology, history, linguistics and the whole range of humanities. Cooperation will be necessary according to the particular type of problems taken up, and anthropology will be best served by an entirely free association with different subjects, according to the need of each case.

It is the opinion of the undersigned committee that the appointment of a director of anthropological work, who would have a dominating influence over organized work, would not be helpful on account of the great diversity of subject matter included in anthropology, and might prove decidedly prejudicial on account of the necessity of developing this subject in different directions. Much better results would undoubtedly be obtained by regular meetings of representative scientists, and by the appointment of a secretary who would carry out the necessary clerical work.

FRANZ BOAS, *Chairman*,
ALEŠ HRDLIČKA,
ALFRED M. TOZZER

NEW YORK CITY,
March 6, 1919

SPECIAL ARTICLES

EGG-WEIGHT AS A CRITERION OF NUMERICAL PRODUCTION IN THE DOMESTIC FOWL[1]

IN connection with a study of the manner of inheritance of egg-weight in the domestic

[1] Contribution 251 from the Agricultural Experiment Station of the Rhode Island State College, Kingston, R. I.

fowl, conducted for several years at the Rhode Island Agricultural Experiment Station, there has been evolved a new method for the detection of those birds in a flock that are characterized by higher producing ability. The method is not based upon data involving observed numerical production in any way, but upon the tendency on the part of normal hens to manifest, at certain periods of the year, a gradual increase or a gradual decline in the size and weight of the eggs which they lay.

It has been found that when the numerical production curve of a flock of hens of the same approximate age and condition, and characterized by mediocre producing ability, is plotted on monthly ordinates (aside from the mode of December production of the pullet year which is sometimes manifested if the hens were hatched very early in the season or are high producers) two modes appear, one in April and one in September. These modes, or maxima, represent the peaks of production for the first laying year.

It has also been found that when the curve of mean egg-weight is plotted on similar monthly ordinates, two modal points appear, one in April and the other in September. These weight modes, or weight maxima, are approximately coincident with the production maxima.

When, however, one analyzes the performance of individual birds at the period of these maxima, one finds that, while the majority show an egg-weight which has markedly increased over the mean weight of the first ten eggs laid at the beginning of the laying year, some have not shown such an increase, and some have shown an actual decrease. When the increase or decrease in mean egg-weight is measured as a percentage-increase or as a percentage-decrease, some birds may show an increase of 10 per cent. or more while others show a decrease of equal amount.

The question naturally arose whether the hens which showed the greater increase in mean egg-weight for April or for September also manifested the higher productions for the first laying year. Such correlations were computed and it was learned that in the majority of cases the hens which gave the higher-percentage increase in egg-weight during these months also showed the higher productions for the year. The flock could easily be separated into production-groups based upon the percentage of increase (or decrease) in mean egg weight. As a rule the correlation was more perfect in September than in April.

Correlations between the percentage of increase in mean egg-weight and numerical production were also attempted when the former were based upon the mean weight of *only ten eggs* laid as nearly as possible to the absolute weight-mode for April and for September respectively. It was learned from these computations that the correlation was even more perfect when the smaller number of eggs was employed in the computations. The following table gives the results for the autumnal weight maximum, based on the "10-egg test."

TABLE I

Showing the Mean Annual Production, for the First Laying Year, of Groups of Hens Selected for Varying Percentages of Increase or Decrease in Mean Egg-weight of Ten Eggs or Less Laid at the Period of the Autumnal Weight Maximum

Percentage-Class: Birds Selected for Increase in Egg-Weight Indicated Below. Per Cent.	Number of Individuals Making the Record	Mean Production for the First Laying Year
> 13	3	147
> 11	6	145
> 10	7	143
> 9	8	144
> 8	10	144
> 7	12	139
> 6	12	139
> 5	14	135
> 4	16	134
> 3	19	131
> 2	21	125
> 1	23	125
> 0	26	124
< 0	5	108
< 6	19	112
Total flock	31	120

From the data presented in the table it appears that higher production is correlated very definitely with higher percentages of increase in egg-weight. The maximum group-production (147) occurred in those hens whose mean increase in egg-weight was above 13 per cent. in the "10-egg test." Selecting above 10 per cent. gave seven birds whose mean production was 143 eggs. Selecting above 6 per cent. gave 12 hens whose mean production was 139 eggs. On the other hand selecting the hens which gave a decrease in egg-weight ("< 0 per cent.," in the table), gave five hens with a mean production of only 108.

The superiority of the "10-egg test" in establishing the correlation with numerical production in this instance clearly brings the testing of egg-production of hens into the same class with testing milk-production of dairy cows, in which case Gavin and also Wilson have pointed out that under suitable conditions the one day test may be of greater value than the seven-day, the 30-day or the year test.

With these points openly in mind, and only with the purpose of stimulating further investigation and discussion, the author presents the following brief summary of his results with a single flock as expressing a biological fact which, if later proved to be of general application, may take its place as a fundamental law of production in the domestic fowl:

The innate egg-producing ability of a hen is manifested, not only by the number of eggs laid within a year, or within some longer or shorter period of time, but also by the degree of increase or of decrease in the mean weight of her eggs, when this increase or decrease (calculated as a percentage-increase or percentage-decrease) is measured at those periods of laying (the vernal and autumnal maxima) characterized by the markedly increased laying of the flock; and on this basis, groups of hens characterized by higher producing ability can be differentiated as accurately as, and more easily than by other known means.

The validity of this proposed law of production is supported by detailed evidence in an article to appear in *The American Naturalist.*

PHILIP HADLEY

R. I. AGRICULTURAL EXPERIMENT STATION

SOCIETIES AND ACADEMIES

THE NATIONAL ACADEMY OF SCIENCES

THE program of scientific sessions of the meeting held in Washington on April 28, 29 and 30, was as follows:

MONDAY, APRIL 28

Morning Session

ALFRED G. MAYOR: The age of the fringing reef of Tutuila, American Samoa.

CHARLES D. WALCOTT: Seaweeds and sponges of the Middle Cambrian.

ROBERT G. AITKEN: The spectra of the visual binary stars.

GEORGE E. HALE, F. ELLERMAN, S. B. NICHOLSON and A. H. JOY: The magnetic polarity of sun spots.

WALTER S. ADAMS and A. H. JOY: The motions in space of some stars of high radial velocity.

WALTER S. ADAMS and G. STRÖMBERG: The use of spectroscopic method for determining the parallaxes of the brighter stars.

ADRIAAN VAN MAANEN (introduced by George E. Hale): Evidence of stream-motion afforded by the faint stars in the Orion nebula.

GRAHAM LUSK and H. V. ATKINSON: The production of fat from protein after giving meat in large quantity to a dog.

WILLIAM S. HALSTED: End-to-end anastomosis of the intestine—experimental study.

ROBERT M. YERKES (introduced by George E. Hale): Psychological examining in the United States Army.

Afternoon Session

FREDERICK H. SEARES (introduced by George E. Hale): Relation between color and luminosity for stars of the same spectral type.

FREDERICK H. SEARES, A. VAN MAANEN and F. ELLERMAN (introduced by George E. Hale): Deviations of the sun's general magnetic field from that of a uniformly magnetized sphere.

W. W. CAMPBELL: The solar corona.

HERBERT E. GREGORY (introduced by W. M. Davis): Plans for exploration of the Pacific.

FRANCIS G. BENEDICT, W. R. MILES and ALICE JOHNSON: The temperature of the human skin.

S. J. Meltzer and M. Wollstein: The influence of degeneration of a vagus nerve upon the development of pneumonia.

Demonstration of war research problems at the National Bureau of Standards.

Evening Session

William Ellery Hale Lecture, by James Henry Breasted, professor of Egyptology and Oriental history, University of Chicago. Subject: *The origin of civilization—from the old stone age to the dawn of civilization.*

Reception to members and guests at the United States National Museum, National Gallery of Art.

TUESDAY, APRIL 29

Morning Session

Edwin H. Hall: The effect of great pressure on the electric conductivity and thermo-electric properties of metals.

Edwin H. Hall: Comments on the results of Bridgman's experiments.

Charles Lane Poor (introduced by J. S. Ames): Line of position computer.

Irving Langmuir: The arrangement of electrons in atoms and molecules.

Henry F. Osborn: Paleomastodon, the ancestor of the long-jawed mastodons only.

Henry F. Osborn: Seventeenth skeletons of *Moropus:* probable habits of this animal.

Thomas B. Osborne and Alfred J. Wakeman: The preparation of vitamine-free proteins.

Arthur G. Webster: Tentative results in interior ballistics.

Arthur G. Webster: Tentative results in elastic hysteresis.

Afternoon Session

Edwin H. Hall: Thermal conduction in metals, from the standpoint of dual electric conduction.

Edwin H. Hall: The thermo-electric equation $P = T\ dV/dT$ once more.

A. O. Leuschner and Sophia H. Levy: Perturbations of minor planets discovered by James C. Watson: (104) Clymene (106), Dione (168), Sibylla (175), Andromache. Read by title.

Arthur G. Webster: The most perfect tuning fork.

Arthur G. Webster: Angle of repose of wet sand.

Edward Kasner: Geometry of the wave equation.

C. G. Abbot: Rotating projectiles from smooth-bore guns (illustrated).

C. G. Abbot: Means for measuring the speed of projectiles in flight (illustrated).

C. G. Abbot: Recent simultaneous measurements of the solar constant of radiation at Mount Wilson, California, and Calama, Chile (illustrated).

John C. Merriam: Human remains from the Pleistocene of Rancho La Brea (illustrated).

William Ellery Hale Lecture, by James Henry Breasted, professor of Egyptology and Oriental history, University of Chicago. Subject: *The origin of civilization—the earliest civilization and its transition to Europe.*

WEDNESDAY, APRIL 30

Afternoon Session

Joint session National Academy of Sciences with National Research Council.

George E. Hale: The past work and future plans of the National Research Council.

John C. Merriam: The Division of General Relations, Section on Relations with Educational Institutions and State Committees.

R. A. Millikan: The Division of Physics, Mathematics, Astronomy and Geophysics.

Dayton C. Miller: Pressures and velocities, internal and external, due to the discharge of large guns.

E. W. Washburn: The Division of Chemistry and Chemical Technology.

A. A. Noyes: Nitrate investigations.

Whitman Cross: The Division of Geology and Geography.

R. G. Hussey: The Division of Medicine and Related Sciences.

R. M. Yerkes: Psychology in relation to the war.

C. E. McClung: The Division of Agriculture, Botany, Forestry, Zoology and Fisheries.

G. H. Clevenger: The Division of Engineering.

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE PHYSIOLOGY OF THE AVIATOR[1]

DOUBTLESS you have all read the delightful historical accounts by the late Admiral Mahan of the great naval battles of the eighteenth century, when France and England struggled for the mastery of the sea. You will recall the stress laid on the weather gauge, or windward position. If the wind blew from the eastward, as does the "northeast trade" among the Caribbean Islands where a great part of the struggle occurred, whichever admiral was able so to maneuver as to be to the east of his enemy obtained a great, and often a decisive, advantage. He could choose the time and mode of attack, while his antagonist was compelled to remain on the defensive, unable either to force the fighting or to escape it.

In modern naval warfare the position of the sun in relation to the enemy's fleet affects the accuracy of aim. The speed of the ships is of importance equalling that of their gunfire. But there is no element of position which quite corresponds to that of the weather gauge for a fleet under sail.

In the battles of the ships of the air, however, there is again a condition which corresponds quite closely to the tactical advantage of maneuvering between the wind and the enemy. In this case it is not a direction in the plane of the horizon, except so far as light is important; but it is the direction at right angles, vertical to this plane. It is the upper position—the advantage obtained by him who can climb above his enemy, and, choosing the moment

[1] Address before the Harvey Society, New York City, March 22, 1919.

of attack, can swoop down upon him from above.

With this as one of the fundamental conditions of aerial warfare, it was inevitable that in the development of the battle plane there should be the utmost effort to produce machines of continually greater speed and, its correlative, climbing power. Likewise in the air, the greatest practicable altitude has meant for the flying man at once an advantage over his enemy and a reduction of his own chance of being hit by anti-aircraft fire from the enemy's guns on the ground.

Accordingly, from the comparatively low altitude at which the aerial fighting of the first year of the war usually occurred, the struggle rose, as more and more powerful airplanes were constructed by both sides, until at the end of the war it was quite common for battle planes to ascend to altitudes of 15,000 to 18,000 feet—three miles up, higher than the summits of the Rocky Mountains or the Alps.

Along with this development there occurred with increasing frequency among the aviators a condition of so-called "air-staleness." It is a condition closely similar to, perhaps identical with, the "overtraining" or staleness, the physical and nervous impairment of athletes in a football team or college crew. In the last year of the war this condition had become so common that, as reported to us by some observers, the majority of the more experienced aviators in the British service were incapacitated to ascend to the necessary altitude, and many could no longer fly at all. It was to make good this most serious military deficiency that the enlistment and training of aviators was undertaken by the American Air Service on the enormous scale that it was. It was for the purpose of testing our airmen initially, and of keeping tab on their physical condition thereafter, that the work at the Mineola laboratory, of which probably you have heard, was undertaken.

It is work which lies in a field of physiology in which before the war not half a dozen men in America, and not many more in Europe, were interested, and for them it was a field of what is called "pure" science. To-day it promises contributions of practical value not only to aviation, but to problems in medicine, climatology, athletics and hygiene.

We will turn then to the problem of the aviator and the methods of human engineering which have been developed for its solution. But first, it will be advisable to review briefly what is known concerning the immediate effects of low barometric pressure and the functional readjustments involved in acclimatization to elevated regions; that is, life at great altitudes.

Paul Bert,[2] the brilliant French physiologist, was the first to demonstrate, in 1878, that the effects of lowered barometric pressure or altitude are wholly dependent on the decreased pressure of oxygen. He carried out experiments upon men and animals both with artificial gas mixtures and reduced barometric pressure in a steel chamber.

He showed that in pure oxygen at 21 per cent. of atmospheric pressure life goes on in practically the same manner as in air, which contains 21 per cent. of oxygen, at the ordinary pressure. So also the breathing of an artificial gas mixture containing only 10.5 per cent. of oxygen has the same untoward effects at sea level that breathing pure air has at an altitude of about 20,000 feet, where the barometer is reduced by one half.

These considerations are fundamental for the differentiation of the disorders in-

[2] Paul Bert, "La Pression Barometrique," Paris, 1878.

duced by rarefied air—so-called mountain sickness—from the conditions resulting from work in compressed air—so-called caisson disease. It is clear that it is from the former, and not at all from the latter, that aviators suffer; but, as the two disorders are sometimes confused, a few words regarding the latter are in place here.

Caisson disease—known also as the "bends," "diver's palsy," and by other names—depends upon the fact that, under the high pressure necessary for diving, tunneling, and other work below water, the the nitrogen of the air dissolves in the blood and in the other fluids and tissues of the body in amounts proportional to the pressure. This in itself does no harm, and has in fact no effect upon the body, until the subject comes out of the pressure lock or caisson, or rises from the depth of the sea where he has been working. Then the nitrogen which has been dissolved begins to diffuse out of the body. This also does no harm and has no effect unless the pressure under which the man has been working is so high, and the lowering of the external pressure is so rapid, that the dissolved nitrogen separates in the form of bubbles. Such bubbles may form in the blood, in the synovial fluid of the joints, and even in the brain. They induce intense pain, and even paralysis and death. In order that bubbles may be formed it is essential, however, that the pressure with which the tissues are in equilibrium should have been lowered considerably more than half its absolute amount in a few seconds.

In the present state of the art of flying it is scarcely possible for an aviator to rise to a height of more than 20,000 feet, where the barometer would be less than half of that at sea level, in a period sufficiently short to allow bubbles of nitrogen to form in this way. The disorders from which aviators suffer are, therefore, of a different class from those to which workers in compressed air are exposed.

When the study of the effects of lowered barometric pressure was begun, it was supposed that the circulation might be primarily disturbed. The blood in the arteries of a healthy man is under such a pressure that, if a glass tube were inserted vertically into one of the arteries of his neck, and the blood were allowed to flow up the tube, the column of blood would come to rest at a height of 4 or 5 feet above his heart, corresponding to pressures of 120 to 150 mm. mercury. Knowing that the air pressure is reduced at great altitudes, some of the earlier writers made the mistake of supposing that such a column of blood would rise higher, and the blood vessels would be under a greater strain, and more likely to burst therefore, at a great altitude that at sea level. That which they looked for they found. One writer has left a lurid description of how, while crossing a pass in the Andes, he got off his mule and walked for a time to rest the animal. On the least exertion his breathing became oppressed, "his eyes bulged and his lips burst." The odd part of this is that in reality the blood vessels are under no greater strain at a high altitude that at sea level. When the air pressure upon the exterior of the body and in the lungs is reduced, a part of the gas —at least the nitrogen dissolved in the blood—rapidly diffuses out through the lungs, so that the gas pressure within and without the blood vessels are again equal just as at sea level. The idea is still prevalent that hemorrhages occur under low barometric pressures. However, among thousands of people whom I had an opportunity to observe on Pike's Peak during a five weeks stay at the summit, I saw not a single nose bleed, except one which was

caused by the forcible application of a hard object to the organ in question.

The only direct effects of changes of pressure are those which are felt in the ears, and occasionally in the sinuses connected with the nose. The ear drums are connected with the throat and contain air at the prevailing pressure. If the pressure is lowered this air expands, and forces its way out through the Eustachian tubes into the throat. If the outside pressure is increased, it sometimes happens, particularly when the subject has a cold and the Eustachian tubes are inflamed, that air does not pass readily into the middle ear. Accordingly the tympanic membranes are forced inward by the pressure; and this may cause acute pain. Workers in compressed air are accustomed, while going "into the air," *i. e.*, into pressure, to hold their noses and blow at frequent intervals as a means for expanding the ear drums. Aviators even during very rapid descents are generally relieved by merely swallowing.

To sum up all that has been said thus far, the influence of low barometric pressure is not mechanical but chemical. Life is often compared to a flame; but there are marked differences, depending upon the peculiar affinity of the blood for oxygen. A man may breathe quite comfortably in an atmosphere in which a candle is extinguished. The candle will burn with only slightly diminished brightness at an altitude at which a man collapses. The candle is affected by the proportions of oxygen and nitrogen. The living organism depends solely upon the absolute amount of oxygen—its so-called partial pressure.

Unlike the flame, a man may become acclimatized to a change of atmosphere in the course of a few days or weeks. He is thus adjusted to the mean barometric pressure under which he lives. Every healthy person is so adjusted, New Yorkers to a mean barometric pressure of 760 mm. no less than the inhabitants of Denver or Cripple Creek to their altitudes. Even your tall buildings could probably be shown to exert a slight climatic effect upon the tenants of the upper stories. The study of the processes involved in such acclimatization affords us one of the most promising means of analyzing some of the fundamental problems of life. In fact, is not the gaseous interchange of protoplasm, the carbon and oxygen metabolism of the cell, the central fact of life? Is not the mode of regulation of the interior environment of the body—the constants of the "humours"—the prime problem of the "vegetative" side of physiology.

Among the ill effects of lack of oxygen we may distinguish three more or less distinct conditions. They are comparable, in terms of more common disorders, to acute disease in contrast with chronic conditions of various degrees. Thus any one suddenly exposed to acute deprivation of oxygen, as is the balloonist or the aviator in very lofty ascents, shows one set of symptoms. If the exposure is less acute, as in the case of one taking up residence on a high mountain, the effects develop gradually; he passes through the stages of mountain sickness, a condition much like sea sickness, to a state of acclimatization and renewed health. If however the ascent or the flight is for only two or three hours, a period too short for any degree of acclimatization to develop, and this strain on the oxygen-needing organs is repeated daily, as is the case with the aviator of the upper air, the condition of "air staleness" is likely sooner or later to result. It is the effect of repeated slight oxygen deficiency on an individual who does not become acclimatized. It is, I believe, closely related to those effects of repeated over-exertion

and oxygen shortage which appear in the over-trained athlete.

The classic description of collapse from oxygen deficiency is that written by Tissandier,[3] the sole survivor of a fatal balloon ascent in 1875.

I now come to the fateful moments when we were overcome by the terrible action of reduced pressure. At 7,000 meters (Bar. 320 mm.) we were all below in the car. . . . Torpor had seized me. My hands were cold and I wished to put on my fur gloves; but without my being aware of it, the action of taking them from my pocket required an effort which I was unable to make. At this height I wrote, nevertheless, in my notebook almost mechanically, and reproduce literally the following words, though I have no very clear recollection of writing them. They are written very illegibly by a hand rendered very shaky by the cold. My hands are frozen. I am well. We are well. Haze on the horizon, with small rounded cirrus. We are raising. Crocé is panting. We breathe oxygen. Sivel shuts his eyes. Croce also shuts his eyes. I empty aspirator. 1.20 P.M.,–11°, Bar. 320. Sivel is dozing. 1.25–11°, Bar. = 300. Sivel throws ballast. Sivel throws ballast. (The last words are scarcely legible.) . . . I had taken care to keep absolutely still, without suspecting that I had already perhaps lost the use of my limbs. At about 7,500 meters (Bar. 300 mm.) the condition of torpor which comes over one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. On the contrary one feels an inward joy. There is no thought of the dangerous position; one rises and is glad to be rising. The vertigo of high altitudes is not an empty word; but so far as I can judge from my own impressions this vertigo appears at the last moment, and immediately precedes extinction, sudden, unexpected and irresistible. . . . I soon felt myself so weak that I could not even turn my head to look at my companions. I wished to take hold of the oxygen tube, but found that I could not move my arms. My mind was still clear, however, and I watched the aneroid with my eyes fixed on the needle, which soon pointed to 290 mm. and then to 280. I wished to call out that we were now at 8,000 meters; but my tongue was paralyzed. All at once I shut my eyes and fell down powerless, and lost all further memory. It was about 1.30.

[3] Quoted from Paul Bert, *op. cit.*, p. 1061.

In this ascent the balloon continued to rise until a minimum pressure, registered automatically, of 263 mm. was reached. When Tissandier recovered consciousness Sivel and Crocé-Spinelli were dead. They were all provided with oxygen, ready to breath; but all were paralyzed before they could raise the tubes to their lips. Tissandier's notes are characteristic of the mental condition when oxygen-want is becoming dangerous.

In marked contrast to this condition is that of men who, gradually ascending into the mountains, day by day become acclimatized without realizing that any change has occurred. The record for the greatest altitude attained by mountaineers is held by the Duke of Abruzzi and his party in the Himalayas. They reached an altitude of 24,000 feet, where the atmospheric pressure is only two fifths of that at sea level, or practically the same as that at which Tissandier's companions lost consciousness. At this tremendous altitude the Duke and his Swiss guides were not only free from discomfort, but were able to perform the exertion of cutting steps in ice and climbing. Dr. Filippi, the physician who accompanied them, in discussing this matter says that the fact of their immunity admits of but one interpretation:

Rarefaction of the air under ordinary conditions of the high mountains to the limits reached by man at the present day (307 mm.) does not produce mountain sickness.[4]

In this statement, however, he is certainly mistaken, for the observations of others show conclusively that the sudden exposure of unacclimatized men to an altitude considerably less than that reached by this party would either produce collapse like that of Tissandier's companions, or if long

[4] Quoted from Douglas, Haldane, Henderson and Schneider, "Physiological Observations on Pikes Peak," *Phil. Trans.*, 1913, B. 203, p. 310.

continued would result in mountain sickness. The latter effect especially is one which was the subject of careful study by an expedition of which I was a member, and which during the summer of 1911 spent five weeks at the summit of Pike's Peak, Colorado, altitude, 14,100 feet, Bar. 450 mm. We were there enabled to make observations upon hundreds of tourists who ascended the Peak, and who were acclimatized at most to the altitude of Colorado Springs or Manitou at the foot of the mountain. We saw a number of cases of collapse—fainting—from oxygen deficiency as shown by the striking cyanosis.

In the majority of cases, however, tourists who spent no more than the regulation half hour at the summit of the Peak, and then descended, experienced no acute ill effects. Headache and some degree of nausea were common even among these persons, however—often developing slowly for some hours after their descent. On the other hand, among persons who remained over night, and were thus exposed for several hours to deficiency of oxygen, the classic symptoms of mountain sickness occurred; and few escaped. Their second day at the summit was marked usually by extreme discomfort—headache, nausea, vomiting, dizziness and extraordinary instability of temper—symptoms which were strikingly exacerbated by even the smallest use of alcohol.

Our immediate party passed through these conditions and after two or three days, or in one case nearly a week, re-attained practically normal health. A definite functional readjustment had occurred. To illustrate and emphasize the nature of this readjustment I will quote a recent experiment[5] of my friend the leader of the Pike's Peak expedition, Dr. J. S. Haldane.

He has equipped his laboratory at Oxford with a small lead-lined chamber in which a man can be hermetically closed. The carbonic acid which he exhales is continually absorbed by alkali, so that no accumulation occurs, while the oxygen is progressively decreased by the breathing of the man himself. Dr. Haldane found that after a day or two in this chamber he had reduced the oxygen to an extent comparable to Pike's Peak. At the same time there had evidently occurred in himself a gradual process of adjustment, for he felt quite well. At this stage he invited another person to come into the chamber with him, and he had the satisfaction of observing the immediate development of blueness and the other symptoms of oxygen collapse in his companion.

Evidently acclimatization is a very real phenomenon and of the utmost importance to any one exposed to a lowered tension of oxygen.

As we observed it in ourselves during our stay on Pike's Peak acclimatization consists in three chief alterations: (1) increased number of red corpuscles in the blood; (2) some change in the lungs or blood (Haldane considers it the secretion of oxygen inward by the pulmonary tissue) which aids the absorption of oxygen, and (3) a lowering of the CO_2 in the alveolar air of the lungs. This lowering of the CO_2 in the lungs is bound up with increased volume of breathing. It is the concomitant of a decreased alkaline reserve in the blood just as in nephritis and diabetes. Acclimatization in this respect consists therefore in the development of a condition which would nowadays be called acidosis.

All of these changes are of a quantitative character. Miss FitzGerald[6] has supplemented the results obtained on Pike's Peak by an extensive series of careful observa-

[5] Personal communication.

[6] FitzGerald, M. P., *Phil. Trans.*, 1913, B. 203, p. 351, and *Proc. Royal Soc.*, 1914, B. 88, 248.

tions on the inhabitants of towns of closely graded altitude from sea level up to that of the highest inhabited place in our western country. She has thus shown that the mean hemoglobin and the mean alveolar CO_2 of the inhabitants of any town are functions of the mean barometric pressure of the place.

I shall not discuss pulmonary oxygen secretion now, because the problem is still extremely obscure; nor the increased production of red blood corpuscles, which is a slow process requiring weeks for completion, and playing no considerable part in the matter particularly before us.

We will fix our attention upon the fact that both the alveolar CO_2 of the pulmonary air and the alkaline reserve of the blood are reduced in accurate adjustment to any altitude, or oxygen tension, to which a man is subjected for a few days or even a few hours. This functional readjustment is, I believe, of great significance in relation to aviation, since it involves a larger volume of breathing per unit mass CO_2 eliminated: it thus compensates in part for the rarefaction of the air.

But how is it brought about? And why are the changes of breathing gradual, when the changes of altitude and oxygen tension are abrupt? The answer lies in part at least in the mode of development, and the nature of that acidosis of altitude to which I have referred. It is scarcely necessary to remind you that, as L. J. Henderson has shown, the balance of acids and bases in the blood, its C_H, depends upon the maintenance of a certain ratio between the dissolved carbonic acid, H_2CO_3 and sodium bicarbonate, $NaHCO_3$, or as Van Slyke terms it, the alkaline reserve. On the basis of this conception the prevalent view of acidosis is that, when acids other than carbonic are produced in the body, the bicarbonate is in part neutralized. The alkaline reserve is thus lowered, and the carbonic acid of the blood being now in relative excess, an increased volume of breathing is caused as an effort at compensation.

Recent investigations[7] by Dr. H. W. Haggard and myself show that an exactly opposite process is likewise possible. We find that whenever respiration is excited to more than ordinary activity, and the carbonic acid of the blood is thus reduced below the normal amount, a compensatory fall of the alkaline reserve occurs. The body is evidently endowed with the ability to keep the ratio of H_2CO_3 to $NaHCO_3$ normal, not only by eliminating CO_2 when the alkali is neutralized, but also by the passage of sodium out of the blood into the tissue fluid (or by some equivalent process) to reduce the alkaline reserve. A loss of CO_2 during over-active breathing is thus balanced. If it were not balanced a state of alkalosis would occur, which would inhibit and induce a fatal apnoea.

It is really in this way I believe that some of those conditions arise which nowadays are called "acidosis." If so they are not truly acidosis, or rather the process producing them is not acidosis, although the resultant condition gives some of the most characteristic tests of this condition. It is on the contrary a state, or rather a process, which Mosso was the first to recognize, although obscurely, and which he termed "acapnia" an excessive elimination of CO_2. Recent papers[8] from my laboratory have shown that a sudden and acute acapnia induces profound functional disturbances, including circulatory failure.

It is one of the well-known facts in physi-

[7] Henderson and Haggard, *Jour. Biol. Chem.*, 1918, 33, pp. 333, 345, 355, 365.

[8] Henderson and Harvey, *Amer. Jour. Physiol.*, 1918, 46, p. 533, and Henderson, Prince and Haggard, *Jour. Pharmac. Exper. Therap.*, 1918, 11, p. 189.

ology that deficiency of oxygen, or anoxemia, causes an "acidosis." Recent and as yet unpublished work of Dr. Haggard and myself indicates that the process involved is almost diametrically the opposite of that which has heretofore been supposed to occur, and that the result is not a true acidosis. Under low oxygen, instead of the blood becoming at first more acid with a compensatory blowing off of CO_2, what actually occurs is that, as the first step, the anoxemia induces excessive breathing. This lowers the CO_2 of the blood, rendering it abnormally alkaline; and alkali passes out of the blood to compensate what would otherwise be a condition of alkalosis.

We regard the current explanation, based on the production of lactic acid, as needing reversal.

The application of this idea to the changes of breathing and of the blood alkali in acclimatization clears up some of the points which heretofore have been obscure. Thus on Pike's Peak we saw that persons whose breathing under the stimulant of oxygen deficiency increased quickly to the amount normal for the altitude suffered correspondingly little, while those whose respiratory center was relatively insensitive to this influence suffered severely. The one type readily developed the acapnia and in consequence the pseudo-acidosis which the altitude requires. The other did not.

Here let me pause a moment to bring these conceptions into some degree of harmony with fundamental doctrines regarding respiration. For more than a century, in fact ever since the days of Lavoisier, the argument has been active whether our breathing is controlled by oxygen need or by the output of CO_2. For the past thirty years, and especially during the last ten or twelve, the theory of regulation by CO_2, or in its later form by C , has held the field. Indeed it is established now—almost beyond the possibility of contradiction, it would seem—that during any brief period of time, and under conditions to which the individual is accustomed, the amount of CO_2 produced in the tissues of the body, through its influence on the C_H of the blood, is the factor controlling the volume of air breathed. Its effects are immediate.

But when we view the matter more broadly it is clear that this is by no means the whole story. The oxygen tension of the air is the influence which determines just how sensitive the respiratory center is to excitement by CO_2. But the effects of any change of oxygen tension are slow in developing, requiring in some persons, as we saw on Pike's Peak, hours to begin and several days to become complete. In fact there are many perfectly healthy persons who, if caused to breathe progressively lowered tensions of oxygen down to 6 or 7 per cent. in the course of half an hour, feel nothing. Their breathing shows no considerable augmentation. They simply lose consciousness, and if left alone they would die, without any apparent effort on the part of respiration to compensate for the deficiency of oxygen. In such persons the stimulant of oxygen deficiency exerts only a slowly developing influence upon the sensitiveness of the respiratory center to the stimulus of CO_2. They can become acclimatized to great altitude only at the cost of prolonged mountain sickness. Evidently they are not suited to be aviators.

In very sensitive subjects, on the contrary, the period of readjustment is much shorter. It is a matter not of days but of hours, and the functional alterations begin to develop almost immediately even under slight oxygen deficiency. The upper air is for those men whose organization readily responds with vigorous compensatory reacgen.

With this inadequate sketch of present scientific knowledge regarding life at great altitudes as a background, we may turn to the application of this knowledge to the problems of human engineering in the aviation service of our army during the war. In September, 1917, I was appointed chairman of the Medical Research Board of the Air Service and was asked to lay out a plan for the development of a method of testing the ability of aviators to withstand altitude.

You will readily guess the line along which one would attack such a problem. It consisted in the development of an apparatus from which the man under test breathes air of a progressively falling tension of oxygen. The particular form which we use is called a rebreathing apparatus. It consists of a steel tank holding about 100 liters of air, connected with a small spirometer to record the breathing, and a cartridge containing alkali to absorb the CO_2 which the subject exhales. Breathing the air in this apparatus through a mouthpiece and rubber tubing the subject consumes the oxygen which it contains, and thus produced for himself the progressively lower and lower tensions of oxygen which are the physiological equivalent of altitude. To control and test the accuracy of the results with the rebreathing apparatus we installed in our laboratory at Mineola a steel chamber, in which six or eight men together can sit comfortably, and from which the air can be exhausted by a power driven pump down to any desired barometric pressure.

Such apparatus was however only the beginning. The practical problem was to determine the functional changes—pulse rate, arterial pressure, heart sounds, muscular coordination and psychic condition occurring in the good, the average and the poor candidates for the air service, and then to systematize and introduce these standards on a very large scale at the flying fields in this country and in France.

That this program was successfully carried through, and was approaching completion when the armistice was signed, was due chiefly on the scientific side to the brilliant work of my colleagues Majors E. C. Schneider, J. L. Whitney, Knight Dunlap and Captain H. F. Pierce, and on the administrative side to the splendid cooperation of Colonel W. H. Wilmer and Lieutenant Colonel E. G. Seibert.

We have recently published a group of papers,[9] brief but fairly comprehensive in their technical details, and I shall not now repeat what has there been said, but shall confine myself to a few salient points. One of these is a final and striking demonstration of our main thesis. Schneider and Whitney went into the steel chamber and the air was pumped out of it until the barometer stood at only 180 mm., 23 per cent. of the pressure outside: the equivalent of an altitude of 35,000 feet. Throughout the test they were supplied with oxygen from a cylinder through tubes and mouthpieces. They experienced no discomfort except from flatus: the gases of the stomach and intestine of course expanded nearly five fold.

In comparison with this observation is to be placed the recent record ascent by Captain Lang and Lieutenant Blowes in England to a height of 30,500 feet. They were supplied with oxygen apparatus; but a defect developed in the tube supplying Lieutenant Blowes and he lost consciousness. Captain Lang seems to have suffered only from cold.

From this it might appear that the

[9] Y. Henderson, E. G. Seibert, E. C. Schneider, J. L. Whitney, K. Dunlap, W. H. Wilmer, C. Berens, E. R. Lewis and S. Paton, *Journal American Medical Association*, 1918, Vol. 71, pp. 1382–1400.

simplest way to solve the problem of lofty ascents would be by means of oxygen apparatus. The Germans evidently made use of such apparatus, for it was found in the wreck of one of the German planes shot down over London. The British also had such apparatus, but it was difficult to manufacture, wasteful in operation, and in other respects left much to be desired. In fact the devising of such apparatus and its adaptation to the peculiar requirements of the human wearer are a problem which can be solved only by the close cooperation of a physiologist and a mechanical engineer. Mr. W. E. Gibbs, of the Bureau of Mines, with whom I had cooperated in developing mine rescue oxygen apparatus, took up this problem and produced a device which should prove valuable. Unfortunately the common tendency to favor ideas and apparatus coming to us from Europe operated against the adoption of the better American device.

It is doubtful however whether any apparatus of this sort will ever quite take the place of physical vigor and capacity to resist oxygen deficiency on the part of the aviator himself. Imagine him, when fighting for his life above the clouds, handicapped by goggles over his eyes, wireless telephone receivers on his ears, a combined telephone transmitter and oxygen inhaler over his mouth, and a padded helmet on his head!

The importance of determining the aviator's inherent power of resistance to oxygen deficiency, if he is to be even for a few moments without an oxygen inhaler, is demonstrated by the results of the routine examinations made with the rebreathing apparatus in the laboratory. These results show that 15 to 20 per cent. of all the men who pass an ordinary medical examination are unfit to ascend to the altitudes now required of every military aviator. On the other hand these tests pick out a small group of 5 to 10 per cent. who, without apparent immediate physical deterioration, withstand oxygen deficiency corresponding to altitudes of 20,000 feet or more.

It is particularly interesting to note that when the rebreathing test is pushed beyond the limit that the man can endure, be it the equivalent of only 10,000 or 25,000, two different physiological types with all gradations between them are revealed. The fainting type collapses from circulatory failure and requires an hour or two to recover. Often the heart appears distinctly dilated. The other and better type, on the contrary, goes to the equivalent of a tremendous altitude on the rebreathing apparatus and loses consciousness, becoming glassy-eyed and more or less rigid, but without fainting. When normal air is administered such men quickly recover.

Perhaps I ought to say at least a few words regarding the other aspects of the work at Mineola: for example the valuable psychological investigations and the controversy over the rotation tests, which has figured so largely in our medical journals of late. It seemed best, however, to confine myself this evening to my own special field. Nevertheless I can not suppress a public expression here of my sympathy for the brave and able scientific men in the psychological group at Mineola, who insisted on investigating the validity of the rotation tests. I am sure that you will feel as I do, when I tell you that they were threatened with punishmnet for insubordination when they refused to recognize that a regulation of the army, which prescribes the duration of nystagmus after the rotation test, necessarily makes this a physiological fact.

I would gladly devote a few minutes also to pointing out some of the lessons to be drawn from the rather unusually good opportunities which fell to my lot to observe

the mingling of science and militarism. The chief lesson can be put in a single phrase: They do not mix. The War Gas Investigations, which formed the nucleus on which the Chemical Warfare Service finally developed, and the Medical Aviation Investigations, of which I have spoken this evening, were both successful largely because at first they were developed under civilian control, under that splendid scientific arm of the government, the Bureau of Mines and its able director. It is a wise provision of our government by which the Secretary and Assistant Secretaries of War are always civilians. It would also be wise for the general staff in any future war to keep scientific men on a scientific status instead of practically forcing them into uniform.

We all hope that we are done with war, and with soldiers—at least for a generation. We can, however, derive certain broad lessons applicable to the conditions of peace from the experiences and intense activities of war, when almost unlimited funds were obtainable for research and the experiences ordinarily scattered over years were crowded into a few months. One of these lessons is that scientific men need to develop the capacity to become the heads of large enterprises without ceasing to be scientific, without degenerating, as is too often the case, into the super-clerk, who seems to be the American ideal of the high executive official. It is not enough for the scientific man to become the expert adviser to the unscientific administrator. If the latter has the responsibility he will use his power as he, and not as the scientific man, sees fit. To this rule I have known only one splendid exception.

For the most part among us the great prizes go to the man who works up through clerical rather than through expert lines. We must find some way to change this. The path of science must lead to the top, and at the top must still be science. To achieve this ideal, the scientist must show generosity toward colleagues and subordinates, an enthusiastic recognition of their merit and an abnegation of self-aggrandizement, no less than skill in plan and energy in execution. It is essential also that he should develop methods for conserving time and strength by assigning clerical work to clerks instead of becoming a clerk himself, in order that he may keep mind and desk clear for the really important things.

The Chemical Warfare Service was a success largely because the chief of the Research Division followed these principles as the spontaneous promptings of science and patriotism.[10] Medical research in aviation was productive just so long as it pursued a similar course.

He who charts this course, so that others may follow it through the pathless seas of the future, will make a great contribution to science, education, government, and indeed to nearly every phase of trained activity in America.

YANDELL HENDERSON

YALE UNIVERSITY

A NEW DEPOSIT OF URANIUM ORE[1]

HITHERTO the known deposits of radium-uranium ore of commercial importance in the United States have been confined to the carnotite fields of Colorado and Utah, and to a much smaller extent to the pitchblende of Gilpin county, Colorado. In the spring of 1918, a new uranium deposit was discovered at Lusk, Wyo., which is hundreds of miles from any other known fields, and which has proved to be the first isolated deposit of uranium ore to produce commercial quantities. The deposit at Lusk has now proved itself by the

[10] *Cf.* G. A. Burrell, *Journal of Industrial and Engineering Chemistry*, 1918, Vol. II., p. 93.

[1] Published with the permission of the director of the U. S. Bureau of Mines.

production of several carloads of ore containing about 3 per cent. U_3O_8.

The discovery was made quite by accident by Mr. Ross Lambert, of Casper, Wyoming. Having purchased some land near Lusk, without any reference to its mineral value, Mr. Lambert found on the ore dumps of a former silver mine which had been abandoned more than thirty years ago a mineral that attracted his attention by its peculiar yellowish-green color. Mr. Lambert had a complete analysis made of some picked specimens by Mr. W. L. Piers, of Denver, who reported among other things a content of uranium corresponding to more than 20 per cent. of U_3O_8.

In September, 1918, one of the writers had the privilege of visiting the deposit which is situated at Lusk, Wyo., on the Chicago and Northwestern Railway, about twenty miles from the eastern boundary of Wyoming, near the Nebraska-South Dakota intersection. Although considerable prospecting has been done in the region since Mr. Lambert's discovery, the uranium ore so far appears to be confined to a single hill about one quarter of a mile in circumference at its base and tapering up to a sharp conical top about 350 feet above the base. The hill was known by the Indians as Silver Cliff Hill, and still carries this name. It is about one half mile north of Lusk, and lies at the extreme eastern edge of the Hartville uplift. The uranium occurs entirely in quartzite which lies between mica schist and granite. The ore is marked by its extreme variations in appearance. The most typical variety is a greenish-yellow very intimately mixed with quartzite having well rounded grains resembling tapioca in structure and color. However, the predominance of other oxides can completely alter the color and appearance of the ore without the uranium content being affected. For example, a variety containing iron oxide has a rich chocolate-brown color, and yet contains 12 to 15 per cent. U_3O_8 in some cases. Predominance of greenish shades is due to the presence of copper carbonates. Other specimens are black with a glassy lustre, owing to a very intimate mixture of a small quantity of uraninite in the quartzite. In the absence of coloring by these extraneous oxides, the mineral approaches a canary yellow, resembling that of carnotite. In some cases, the colors are found absolutely different in a single piece of quartzite without its chemical composition or the uranium content differing in the various zones. This is due to the high coloring power of a slight predominance of one or the other oxides. A very small proportion of uraninite in the quartzite can color it almost a jet black.

It has been very difficult to obtain pure crystals of the uranium mineral itself suitable for purposes of identification. However, Drs. F. B. Laney and E. D. Larsen, of the U. S. Geological Survey have been kind enough to examine some specimens collected by one of the writers. Dr. Larsen's measurements of the optical properties indicate very decidedly that the mineral is identical with uranophane, a hydrated calcium silicate containing some barium and lead, to which the formula $CaO(UO_3)_2(SiO_2)_2.6H_2O$ has usually been assigned. It is readily soluble in acids. The chemical evidence of the writers does not show correspondence with this chemical formula, but further work, both chemical and optical, is desirable before more definite statements can be made about the crystal form or chemical composition. Dr. Laney's microphotographs of polished sections indicate that the uraninite in the quartzite was introduced subsequent to the deposition of the sandstone and replaced the cementing material, and to a less extent, the sand grains themselves. Dr. Laney believes the mineral is probably an oxidation product of uraninite (U_3O_8).

The chemical evidence of the writers on material not so pure as could be desired (about 80 per cent. pure) indicates that the soluble bases and acids account for each other without reference to the uranium oxide at all. This was taken to indicate the existence of a free higher oxide, probably UO_3. Since the occurrence of this oxide in nature has not been reported, if confirmed, it would con-

stitute a new mineral which it has been proposed to name "lambertite" for its discoverer. As already stated, the confirmation must await further chemical and optical evidence on pure crystals if obtainable.

The present development work of the property has not been sufficient to show how much uranium ore it can be expected to produce. The fact that it has already produced about 100 tons is very encouraging.

The writers have been much indebted by the courtesies extended by Messrs. Ross Lambert and H. A. Duncan, owners of the property, and by Messrs. E. D. Morimer and E. A. Dufford, who were in charge of the property at the time of the writer's visit. It is also an especially pleasant obligation to acknowledge the kind interest and valuable assistance of Drs. Laney and Larsen in the examination of this material.

S. C. LIND,
C. W. DAVIS

GOLDEN, COLO.,
March, 1919

SCIENTIFIC EVENTS

CONFERENCE ON HIGH SCHOOL BIOLOGY

AN educational conference on biology in New York City high schools was held under the auspices of the Brooklyn Botanic Garden, laboratory building, on Friday evening, April 4, 1919, Dr. C. Stuart Gager, director of the Botanic Garden, presiding. The meeting was the outcome of a symposium and conference on botanical education in secondary schools on March 11, under the auspices of the Torrey Botanical Club at the American Museum of Natural History. The conference was composed of members of the faculties of Columbia University, Barnard College, Brooklyn Training School, The Lincoln School of Teachers College, and the scientific staffs of New York Botanical Garden and Brooklyn Botanic Garden. The speakers of the evening included: Dr. R. A. Rexford, representing Dr. John L. Tildsley, associate superintendent of schools, in charge of high schools in New York City; Principals Bogart, of Morris High School (Bronx); Janes, of Boy's High School (Brooklyn); Low, of Erasmus Hall High School (Brooklyn), and Zabriskie, of Washington Irving High School (Manhattan), Principal Denbigh, of Packer Collegiate Institute (Brooklyn); Dr. Edgar A. Bedford, professor of biology in Stuyvesant High School (Manhattan), in charge of a class in general science at Hunter College; Dr. George C. Wood, president of the New York Association of Biology Teachers; Dr. James E. Peabody, chairman, Committee on Biology National Educational Association; Professor R. A. Harper, Torrey professor of botany, Columbia University, and Dr. Otis W. Caldwell, director of the Lincoln School of Teachers College.

The purpose of the meeting was to secure an expression of opinion primarily from administrative officials of New York City high schools as to the actual and possible value of elementary biology as a high-school subject—the proposed introduction of courses in general science and community civics in first year of New York City high schools created the possibility of the elimination or serious curtailment of biology.

It was the unanimous opinion of every speaker that biology, both in content and in educational discipline, contributes something essential in the preparation of young men and young women for citizenship, which is not afforded by any other subject and it was the expressed opinion of all the principals that the elimination or curtailment of general biology from the high-school course of study would be an educational mistake. All of the speakers emphasized the necessity of planning a content of the course so as to make a very intimate and obvious correlation with the everyday life of the individual.

The conference is considered by many as the most important meeting for the consideration of this question that has ever been held in New York City and the result was especially significant in view of a commonly expressed opinion—shown by this conference to be wholly erroneous—that many if not all of the high-school principals were opposed to the subject of elementary biology.

APPOINTMENTS AT HARVARD UNIVERSITY

The following promotions and appointments in the scientific departments are announced:

George David Birkhoff, professor of mathematics. A.B. (Harvard Univ.) 1905, A.M. (*ibid.*) 196, Ph.D. (Univ. of Chicago) 1907. Instructor in mathematics, 1907–09, University of Wisconsin; preceptor in mathematics, 1909–11, professor of mathematics, 1911–12, Princeton University; assistant professor of mathematics, 1912–19, Harvard University.

Cecil Kent Drinker, associate professor of applied physiology. S.B. (Haverford Coll.) 1909, M.D. (Univ. of Pennsylvania) 1913. Instructor in physiology, 1915–16, Johns Hopkins University; instructor in physiology, 1916–18, assistant professor of physiology, 1918–19, Harvard University.

Chester Laurens Dawes, assistant professor of electrical engineering. S.B. (Mass. Institute of Technology) 1909. Assistant in electrical engineering, 1911–12, instructor in electrical engineering, 1912–19, Harvard University; instructor in electrical engineering, 1916–19, Massachusetts Institute of Technology.

William Caspar Graustein, assistant professor of mathematics. A.B. (Harvard Univ.) 1910, A.M. (*ibid.*) 1911, Ph.D. (Univ. of Bonn) 1913. Instructor in mathematics, 1913–14, 1919, Harvard University; instructor in mathematics, 1914–16, assistant professor of mathematics, 1916–19, Rice Institute, Texas.

Lincoln Ware Riddle, assistant professor of cryptogamic botany. A.B. (Harvard Univ.) 1902, A.M. (*ibid.*) 1905, Ph.D. (*ibid.*) 1906. Austin teaching fellow in botany, 1905–06, Harvard University; instructor in botany, 1906–09, associate professor of botany, 1909–18, professor of botany, 1918–19, Wellesley College.

Frederick Albert Saunders, assistant professor of physics. A.B. (Univ. of Toronto) 1895, Ph.D. (Johns Hopkins Univ.) 1899. Instructor in physics, 1899–1901, Haverford College; instructor in physics, 1901–02, associate professor of physics, 1902–05, professor of physics, 1905–14, Syracuse University; professor of physics, 1914–19, Vassar College.

Bancroft Huntington Brown, A.M., instructor in mathematics.

Edward Smith Handy, A.B., Austin teaching fellow in anthropology.

Charles Andrew Rupp, Jr., instructor in mathematics.

Arthur Bliss Seymour, S.M., assistant in the cryptogamic herbarium.

Horace Greeley Perry, A.M., Austin teaching fellow in botany.

John Felt Cole, A.B., instructor in astronomy.

McKeen Cattell, A.M., Austin teaching fellow in physiology.

Neal Tuttle, A.M., Austin teaching fellow in chemistry.

THE NATIONAL ACADEMY OF SCIENCES

At the meeting of the National Academy of Sciences, which took place last week at Washington, the following officers were elected:

Home Secretary: Dr. Charles Greely Abbot, assistant secretary of the Smithsonian Institution.

Treasurer: Frederick L. Ransome, U. S. Geological Survey.

Members of the Council: Colonel John J. Carty, American Telephone and Telegraph Company; Dr. Henry H. Donaldson, Wistar Institute of Anatomy, University of Pennsylvania, and Professor Raymond Pearl, school of hygiene and public health, The Johns Hopkins University.

Members were elected as follows:

Professor Joseph Barrell, geologist, Yale University,

Professor Gary Nathan Calkins, zoologist, Columbia University,

Professor Herbert D. Curtis, astronomer, Lick Observatory, University of California,

Gano Dunn, electrical engineer, New York City,

Professor Lawrence J. Henderson, biologist, Harvard University,

Professor Reid Hunt, pharmacologist, Harvard University,

Professor Treat Baldwin Johnson, chemist, Yale University,

Professor W. J. V. Osterhout, botanist, Harvard University,

Dr. Frederick A. Seares, astronomer, Mount Wilson Observatory, Mount Wilson, California,

Professor William A. Setchell, botanist, University of California,

Major General George O. Squier, electrical engineer, chief army signal officer, Washington, D. C.,

Professor Augustus Trowbridge, physicist, Princeton University,

Professor Oswald Veblen, mathematician, Princeton University,

Professor Ernest J. Wilczynski, mathematician, University of California,

Professor Edwin Bidwell Wilson, mathematical physicist, Massachusetts Institute of Technology.

At the annual dinner of the academy, the Henry Draper Gold Medal was awarded to Charles Fabry, professor of physics at the University of Marseilles, France, and the Alexander Agassiz Gold Medal, established through funds provided by Sir John Murray, was awarded to Prince Albert of Monaco.

The program of the scientific sessions of the academy was printed in the issue of SCIENCE for last week.

SCIENTIFIC NOTES AND NEWS

AT the annual general meeting of the American Philosophical Society held on April 24, 25 and 26, the following were elected to membership: Robert Grant Aitken, Mount Hamilton, Cal.; Joseph Charles Arthur, Lafayette, Ind.; Edward W. Berry, Baltimore; James Henry Breasted, Chicago; Ulric Dahlgren, Princeton; William Curtis Farabee, Philadelphia; John Huston Finley, Albany, N. Y.; Stephen Alfred Forbes, Urbana, Ill.; Chevalier Jackson, Philadelphia; Dayton C. Miller, Cleveland; George D. Rosengarten, Philadelphia; Albert Sauveur, Cambridge, Mass.; William Albert Setchell, Berkeley, Cal.; Julius O. Stieglitz, Chicago; Ambrose Swasey, Cleveland.

COLONEL JOHN J. CARTY, chief engineer of the American Telegraph and Telephone Company, largely responsible for the communications of the American army during the war, has received the rank of commandant of the Legion of Honor.

AT the meeting of the New York Section of the Society of Chemical Industry on April 18, portraits were unveiled by Dr. Charles F. Chandler, of J. B. F. Herreshoff and E. G. Acheson, Perkin Medalists of 1908 and 1910, respectively.

DR. ROBERT KIRKLAND NABOURS, professor of zoology and curator of the natural history museum at the Kansas State Agricultural College, was elected president of the Kansas Academy of Science at its fifty-first annual meeting. Dr. Bernard M. Allen, of the University of Kansas, was elected vice-president, and Dr. W. E. White, also of the university, secretary.

MR. JAMES W. MCGUIRE, of the Coast and Geodetic Survey, has been appointed a member of the U. S. Geographic Board.

DR. W. N. BERG, captain in the Sanitary Corps, stationed at Camp Lee, has received his discharge from the Army and has returned to the Bureau of Animal Industry.

AFTER thirty years' service as chairman of the department of chemistry at Northwestern University, Professor A. Van Eps Young has retired to his farm in North Carolina as professor emeritus.

DR. H. L. CURTIS, of the Bureau of Standards, has gone for a three months visit to European laboratories to obtain data on the progress of certain war problems.

MURRAY P. HOROWITZ, of the Massachusetts Institute of Technology, has been asked to go to Oklahoma, by the Oklahoma Tuberculosis Association, in order to conduct health surveys this summer. Together with the surveys which were completed last summer, the work will represent a state-wide health survey.

THE one hundred and thirteenth annual meeting of the Medical Society of the state of New York was held May 6 to 8, in Syracuse, under the presidency of Dr. Thomas H. Halsted, Syracuse.

THE Paris Academy of Medicine has elected as national associates: Dr. Yersin, director of the Pasteur Institute of Nha-Trang and Dr. Delagenière of Mans.

KING ALFONSO of Spain has signed a decree awarding the Great Cross of the Civilian Order of Alfonso XIII. to Mme Sklodowska Curie, of the University of Paris.

AT the annual meeting of the Chemical Society, London, held on March 27, Sir James J. Dobbie was elected president in succession to Sir William J. Pope.

DR. L. A. BAUER sailed from Liverpool, April 12, for Cape Palmas, Liberia, where, assisted by Lieutenant H. F. Johnston, he will make magnetic and electric observations in connection with the solar eclipse of May 29 next. The duration of totality will be nearly 7 minutes at this station. Dr. Bauer expects

to return to London at the end of June. Lieutenant Johnston as soon as possible after the eclipse will rejoin the *Carnegie,* as second in command. During the war he was on duty with the Admiralty Compass Department at Slough, England.

The Montyon prize ($500) has been awarded by the Paris Academy of Sciences to Drs. Henri Guillemard and André Labat, of Paris, for their researches on asphyxiating gases.

The Adams Prize of the University of Cambridge has been awarded to Professor J. W. Nicholson, F.R.S., for an essay on "Diffraction."

According to the *Proceedings* of the Washington Academy of Sciences Dr. Olaf Andersen of the Mineralogical Institute, Kristiania, and Professor Sem Sealand, professor of physics and rector of the Technological Institute of Norway, at Trondhjem, have been visiting Washington.

Dr. J. N. Van der Vries has resigned his position as professor of mathematics at the University of Kansas to continue his work as secretary of the central district of the Chamber of Commerce of the United States, with headquarters at Chicago.

Professor Arthur A. Neish is giving before the Institute of Arts and Sciences of Columbia University four lectures on "Liquid air; chemistry and the war."

The annual joint meeting of the University of Pennsylvania Chapters of the Sigma Xi and Phi Beta Kappa Societies was held on May 1. The address was by Dr. William E. Safford, economic botanist, U. S. Department of Agriculture, former governor of the island of Guam, Pacific ocean, on "Plants in the arts and industries of the ancient Americans."

The Yale Medical Alumni Association Lecture for this year was given on April 4 by Dr. William Gilman Thompson, of New York, on the Functional restoration of the disabled soldier and civilian.

The Ramsay Memorial Committee has offered to the University of London a sum of not less than £25,000 towards the foundation of a laboratory of chemical engineering at University College.

Charles Brinkerhoff Richards, for twenty-five years Higgins professor of mechanical engineering at Yale University, and for the last nine years emeritus professor, died on April 20, in his eighty-sixth year.

Nature records the deaths of Sir James MacKenzie Davidson, the distinguished ophthalmic surgeon and radiologist, and of Dr. William Allen Sturge, author of papers on prehistoric ethnology.

R. W. H. Row, lecturer in zoology at King's College, London, died on February 16, at the age of thirty-four years.

The death is announced of Dr. K. H. v. Bardeleben, professor of anatomy at the University of Jena and author of a long series of works on anatomy and evolution at the age of sixty-nine years, and of Dr. R. Kobert, professor of pharmacology, physiologic chemistry and the history of medicine at the University of Rostock, an authority on materia medica and physiologic chemistry, aged sixty-five years.

The New England Federation of Natural History Societies held its annual meeting on April 25 and 26 in the Massachusetts Institute of Technology. This is a federation of some thirty societies of the New England states which has an annual gathering in Boston, at which the representatives of the different associations exchange experiences in matters of natural history. Delegates were present from Springfield, Mass.; Worcester, Mass.; Providence, R. I.; New Bedford, Mass.; Lawrence, Mass., and points in Maine and New Hampshire. There were exhibitions of various items in methods of handling specimens.

The American Astronomical Society will hold its annual meeting in Ann Arbor from September 1 to 3. It is announced that there will be in attendance at the conference, representatives from the observatories of Greenwich, Oxford, Cambridge, Vienna and Potsdam.

EDUCATIONAL NOTES AND NEWS

MR. AND MRS. WILLIAM FITZHUGH have given $12,000 to the medical school of Stanford University for the purchase of one gram of radium, for use in the actinography department of the University Hospital. The net income is to be used for clinic beds for indigent patients, particularly for those who need either X-ray or radium treatment.

THEODORE HOOVER, consulting engineer, has been appointed professor of mining and metallurgy in Stanford University.

PROFESSOR W. LEE LEWIS, of Northwestern University, has been elected chairman of the department of chemistry to succeed Professor A. Van Eps Young, who has recently retired. Captain Lewis was in charge of Organic Research Unit No. 3 of the Offense Research Section, C. W. S. during 1918 and is at present assisting Colonel W. D. Bancroft in editing the researches of the American University Experiment Station.

DR. GEORGE W. WILSON, of the Rockefeller Institute for Medical Research, has been appointed head of the department of pathology, bacteriology and preventive medicine in the Loyola University School of Medicine, Chicago.

JULIAN G. LEACH, of the University of Minnesota, has been appointed assistant professor of botany in the Colorado Agricultural College.

DISCUSSION AND CORRESPONDENCE

APROPOS OF THE PROPOSED HISTORICAL SCIENCE SECTION

IN the April 4 number of SCIENCE, page 331, Felix Neumann referred to a proposed "Historical Science" Section of the American Association for the Advancement of Science. If the feasibility of forming such a section is to be seriously considered during the meeting at St. Louis it would be of interest to know how the various sciences would probably be affected by this section. As regards mathematics, in particular, it is very difficult to say what is historical mathematics and what is non-historical mathematics.

As early as 1640 the famous French mathematician and philosopher R. Descartes wrote as follows:

> I am accustomed to distinguish two things in the mathematics, the history and the science. By history I mean what is already discovered, and is committed to books. And by the science, the skill of resolving all questions.

Since the days of Descartes the amount of mathematics committed to books has increased a hundredfold and hence the history of mathematics up to the present time has outgrown the powers of a single man.

Successful mathematical investigators must perforce be mathematical historians as regards their fields of investigation. If these fields are extensive the successful investigators therein require an extensive historical knowledge. Such men are, however, not commonly known as mathematical historians but as mathematical investigators. The former term is usually reserved for those whose historical studies include details relating to the older developments, which usually have little contact with modern advances.

The historical mathematics which is of greatest interest to the investigator engaged in advancing mathematics is usually based on considerable technical knowledge and hence it would scarcely be treated in a section composed largely of non-mathematicians. On the other hand, the historical mathematics which is now commonly known as mathematical history has extensive contact with the history of other sciences and might profitably be treated in such a section. The fact that the proposed name "Historical Science" would be too comprehensive as regards mathematics can scarcely be regarded as a serious objection since the questions which would normally come before such a section would naturally be determined by its membership.

In a broad way it might perhaps be said that the mathematical history suitable for such a general section might include practically all the useful developments in this subject before the beginning of the eighteenth

century, a considerable part of the developments during the eighteenth century, and a very minor part of later developments. The unequal emphasis which such a section would thus place on the different chapters in the history of mathematics would be partly compensated by the fact that it would prepare the way for a more sympathetic attitude towards mathematical history in general.

If such a section is formed it should be understood that the more technical and perhaps the more important part of the history of science is of such a nature that it can be appreciated only by the specialists in the fields to which it relates. There is, however, a great need for work on intercommunicating roads in science and such a section might tend to improve these roads.

G. A. Miller

University of Illinois

VITAMIN TESTS WITH CHICKS

Our experience recently with the use of chicks for the purpose of demonstrating to classes in elementary physiology the rôle of vitamins in a diet has been so satisfactory that we thought it might be of interest to other teachers.

The day-old chick is so universally available, so easily reared, and its growth is so rapid that it makes an admirable laboratory animal for such a demonstration. Because of their hardiness Leghorn chicks were selected and divided into two groups of equal number and weight. Both the control group and the one to be tested (such chicks being easily marked with dye) were placed in the same large cage with free access to water, grit, shell, etc. Both groups were allowed to partake freely from food kept in a feeder. The food thus accessible consisted of either highly milled corn-meal, crumbs of unleavened white flour bread, or cakes baked from rice flour, or combinations of any or all of these. Changes were frequently made so that the chicks ate readily of the food furnished. In addition to this the normal or control group was fed once a day with small amounts of food containing vitamins.

After the second day the curve of the daily average weights showed a marked difference between the two groups. After approximately two weeks the one group began to exhibit the typical symptoms of lack of vitamins. Death occurs so promptly in the young chicks after the onset of symptoms that care must be taken to at once feed the ailing chicks with vitamin containing food. Small amounts of milk, scraped apple, lettuce, etc., sufficed to cause prompt recovery with marked acceleration in the rate of growth.

We of course recognize that no new results have been achieved but felt that the method of demonstration was worthy of note.

R. J. Seymour,
E. P. Durrant

Ohio State University

QUOTATIONS

THE BRITISH AIR-FORCE ESTIMATES AND AERONAUTICAL RESEARCH

The development of military aviation has been one of the wonders of the war, but we have naturally been kept somewhat in the dark as to the exact extent of such development while the war was still in progress. The veil has now been lifted, and General Seely, in speaking on the Air Estimates in the House of Commons on March 13, has given us a striking summary of the progress made during the past four years. The fact that the expenditure on the Air Force has increased two-hundred-fold since the outbreak of hostilities is a sufficient comment on the enormous advances that have taken place in the aeronautical world. General Seely states that if the armistice had not been signed, this year's estimates would have reached the sum of £200,000,000—an amount which is practically four times our pre-war expenditure on the entire navy! Even with the signing of peace in sight the sum of £66,500,000 is asked for, in order to ensure the maintenance of the aerial supremacy which we have gained during the war.

It is exceedingly gratifying to note that the true value of research is at last being appreciated, and the specific provision of £3,000,000

for "civil aviation, experiments and research" will be welcome news to those who hope for the scientific development of commercial flying. General Seely further points out that this sum does not by any means represent the total amount that will be spent on research beneficial to the civilian aviator, since the results of experiments carried out for military purposes and paid for out of the Army Estimates will be equally available for the improvement of commercial machines.

The government has decided that it can not itself undertake commercial flying, but that it will do everything in its power to give encouragement and protection, and it is already announced that the Postmaster-General is prepared to give contracts to private firms which are able to offer approved machines for postal services. Moreover, the government will place most of the military aerodromes of the country at the disposal of civilian pilots for a small fee, and this alone should do much to encourage civilian flying.

In the course of his speech General Seely announced that an important invention in wireless telephony had recently been made, by means of which the wireless operator in an aeroplane was able both to send and to receive messages. It was possible during the war for the leader of a scouting aeroplane squadron to communicate with the others, but it was not practicable to receive an answer. A vacuum valve generator was employed to generate smooth oscillations in the hanging aerial, and a vacuum valve magnifier with a crystal rectifier was used as the receiver. The experimental apparatus was in use in pre-war days, but it required years of research to make it practical and trustworthy.—*Nature.*

SCIENTIFIC BOOKS

The Place of Description, Definition and Classification in Philosophical Biology. By PROFESSOR WILLIAM E. RITTER, in "The Higher Usefulness of Science and other Essays" (4th essay). Richard G. Badger. 1918, Pp. 105–136.

FEW of those who have sometimes harbored mild inward protests against the expansions of subjective biology implied in the organization and interpretation of many of the experimental researches of the day realize the cogency of their unexpressed protests. That accurate thinking regarding biological fundamentals is of first importance for the proper direction and development of biology, science and even of civilization itself is suggested by Professor Ritter in a significant article which has not received nearly the attention it deserves.

Summarily stated Professor Ritter's thesis is as follows: Taxonomy has by many been set aside "as marking a juvenile period in the life of biology"; this appraisal of taxonomy involves a monstrous fallacy; the dominance of individual scientists animated by this mistaken attitude toward systematic zoology and botany has led to unfortunate consequences, both in the development of science and in that of civilization itself.

In science it has given rise to a state of affairs in which the experimental method has been raised to the high place of an end in itself, and has apparently been the stimulus to an extreme of speculation which is perhaps best exemplified by the theoretical conceptions of the German Weismann. In philosophy it has led to the doctrine of the superman, best exemplified in the writings of the German Nietzsche.

On the basis of the assertion that "taxonomic research in both zoology and botany has for years, so far as it has been based on morphology exclusively, taken as one of its guiding principles *neglect nothing,*" Professor Ritter goes on to suggest that we can no longer properly restrict our dictum of "neglect nothing" to morphological attributes alone, "but must extend it to all attributes of organisms whatever—morphological, physiological, ecological, chemical and all the rest." He is of the opinion that a comprehensive review of the whole range of biological results won during the last twenty-five years indicates that each of the main provinces of research "contain differentia corresponding to the systems of classification previously established on the

basis of pure morphology," and says: "No biological phenomenon is adequately interpreted or dealt with experimentally, until it has been considered with reference to the place which the organisms to which it pertains hold in the system of classification." That is, no generalization about the reaction of a species to light, or its chromosomal characters for example, can be accepted as fully valid until compared with the reaction to light or the chromosomal characters of all the other species of the genus, etc. All biologists with extensive field experience will have been struck with the "individualness" in many respects of the distribution, behavior and habit of the different species studied. "Each kind of organism has a chemistry to some extent unique," says Professor Ritter. The same appears to be true of its behavior, ecology, physiology, distribution. Yet nothing is more common, in the literature of present day biology, than generalization for the entire animal kingdom (sometimes even including man), on the basis of the experimental study of a single organism, perhaps among the Protozoa, Insecta or Aves!

Dr. Ritter calls attention to a fact which seems to have been missed by not a few biologists particularly in the fields of cytology and biochemistry, namely, that work in the "analysis" or "causal analysis" of organisms, in so far as the work really has an objective basis, is nothing more than a part of the description of the organism. In other words, analysis and explanation are only species of the genus description. "The sooner it is borne in upon the minds of all students of living beings, no matter with what aspects of such beings they may be occupied, that they are engaged in the great task of describing and classifying the living world; and, so far as 'pure biology' is concerned, are doing nothing else, the sooner will objective biology get itself set off from subjective biology and the sooner will philosophical biology become purged of the many morbific growths which now impair its health and mar its beauty."

"Never more than in the present day," says Professor Ritter, "when experimental research has found so wide and lasting, and, on the whole, beneficent a hold in biology has there been need of fidelity to description and classification." The emphasis is not so much on the shortcoming or even the incompleteness of the experimental method as on the great need for researches which shall inform us as to the "normal behavior of normal organisms under normal conditions."

Probably few would be willing at this stage of scientific development to go all the way with Professor Ritter in his apparently thoroughgoing skepticism regarding some of the popular biological concepts of the day, *e. g.*, those of the "germ plasm" and the "fit"; and it is quite certain that his implication of a lack of regard for and appreciation of the orderliness and unity of living nature on the part of the dominant school of biologists of the day is not wholly justified; but the note of warning he sounds as to the tendency "to neglect everything except the one or a very few things which the experimenter must of necessity make the object of each special piece of work" is one which deserves emphasis.

There are signs of a growing realization on the part of scientific men that recent tendencies to minimize the importance of description and classification in biology are unhealthful; and that with this realization is associated a tendency to utilize in greater measure the natural history mode of philosophizing of which Professor Ritter speaks and which he so highly recommends.

The war has taught scientific men, philosophers and people generally, the overwhelming necessity for right thinking about life and living, if we are to avoid additional cataclysms in the future.

WALTER P. TAYLOR

BUREAU OF BIOLOGICAL SURVEY

SPECIAL ARTICLES

TO CUT OFF LARGE TUBES OF PYREX GLASS

ON a number of occasions I have heard the remark from instructors in physics and chemistry, who do most of their own glass blowing, that they are unable to "cut" off squarely

large tubes of pyrex glass. Small tubes, up to about 20 mm. in diameter, yield readily to the usual file mark.

A well-known method for cutting large tubes of common glass is to make a file scratch round the tube, apply one turn of an iron wire held taut, and then heat the same to redness by an electric current.

This method, however, without modification, fails when attempting to cut pyrex tubes. The glass will simply not crack, and if the heating is pushed the hot wire usually sinks into the glass and finally fuses under the intense heat.

I was surprised recently to find that if the iron wire is replaced by a nichrome wire, say, of no. 14 or 16 gauge, the tube may be *cut* off by the incandescent wire in the same manner that a cake of soap is cut in two parts by means of a string.

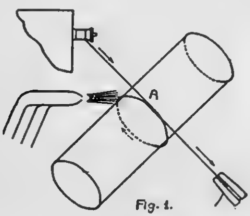

Fig. 1.

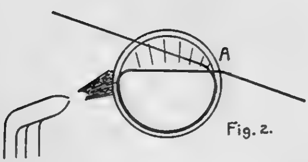

Fig. 2.

To insure success proceed as follows: Take a length of about one foot of nichrome wire, connect it up to a D. C. (or A. C.) dynamo current and include an adjustable tin resistance (for the current required must necessarily be large). The wire is held under tension by pulling on it with a pair of pincers, as shown in Fig. 1. Care must be taken not to let the two parts of the wire touch at *A*. When all is in readiness, turn on the heating current and adjust same by means of the tin resistance until the wire glows a white heat. If now a blast from a hand torch be allowed to play on the wire and glass the tube may be cut as shown in Fig. 2. Be careful not to let the flame strike the glowing wire where it is not in contact with the glass for the extra heat will burn it. The object of the blast is to aid in softening the glass, and also to distribute the heat along the tube and thus prevent the freshly cut edges from checking due to the otherwise intense local heating. The burr of glass that results from the cutting may be removed by a file or on the grindstone.

Recently the neck of a twelve-liter pyrex Florence flask was cut off with the greatest ease. The diameter was about 60 mm., and the wall thickness about 2.5 mm.

CHAS. T. KNIPP
UNIVERSITY OF ILLINOIS

THE ILLINOIS STATE ACADEMY OF SCIENCE

THE twelfth annual meeting of the Illinois State Academy of Science was held at Jacksonville, Ill., on March 21 and 22, having been postponed a month on account of the prevalence of influenza.

Important items of business transacted were the following: It was voted that the academy become affiliated with the American Association for the Advancement of Science, on the plan proposed by the committee on affiliations, of the American Association. It was voted that the academy become affiliated with the Division of State Museum of the Department of Registration and Education of the State Government. It was voted that the academy seek affiliated relations with science clubs in high schools, colleges and elsewhere in the state and a committee was appointed to perfect a plan for such affiliations. A committee on secondary-school science instruction was appointed. This committee is to make annual reports to the academy and to ask the aid and cooperation of the academy in its efforts to further the interests of such instruction. It was voted to offer for sale to libraries and individuals, full sets of the ten volumes of transactions now published at $5 per set.

Through the affiliated relation of the academy with the state museum, the former is practically guaranteed financial aid from the state for the

publication of its transactions. A bill providing one thousand dollars a year is now pending before the legslature, this item having been included in the budget submitted to the legislature by the governor.

The following is the program of papers and addresses presented at the meeting

PAPERS OF GENERAL INTEREST

Dr. H. S. Pepoon, Lake View High School, Chicago, "A proposed state park."

Dr. Chas. F. Millspaugh, Field Museum, Chicago, "Botany in a public museum."

Dr. Frank C. Baker, University of Illinois, "The Museum of Natural History of the University of Illinois."

J. L. Pricer, State Normal University, "Current tendencies in science education in the secondary schools."

William A. Dunkley, Geological Survey Division, "The use of central district coals in water-gas manufacture."

Gilbert H. Cady, Geological Survey Division, "The Illinois pyrite inventory."

Mr. F. E. Kempton, University of Illinois, "The Barberry Eradication Campaign."

REPORTS ON THE FORESTRY SURVEY OF ILLINOIS

Professor S. A. Forbes, State Laboratory of Natural History, "General plans and purposes of the survey."

Professor W. S. Waterman, Northwestern University; Professor H. C. Cowles, University of Chicago; Miss Hazel Schmoll, University of Chicago, "The survey of Cook County."

Dr. H. S. Pepoon, Lake View High School, Chicago, "Jo Daviess County."

Dr. George D. Fuller, University of Chicago, "La Salle County."

Mr. O. D. Frank, Quincy High School, "Adams County."

Dr. W. B. McDougal, University of Illinois, "Vermilion County."

Dr. Arthur G. Vestal, Eastern State Normal School, Charleston, "Cumberland County."

Symposium on Science and Reconstruction: The effects of the war on science and the opportunities and responsibilities of science under the new order of things.

Dr. Roger Adams, University of Illinois, "Chemistry."

F. W. De Wolf, Chief of Division of Geological Survey, "Geology."

Professor John M. Coulter, University of Chicago, "Botany."

Professor Henry B. Ward, University of Illinois, "Zoology."

Dr. C. St. Clair Drake, Chief of Department of Public Health, "Medicine and public health."

Dean Eugene Davenport, College of Agriculture, University of Illinois, "Agriculture and food production."

PAPERS ON BOTANY

Professor William Trelease, University of Illinois, "The scarlet oak of northern Illinois."

Professor Henry C. Cowles, University of Chicago, "Some floristic and ecological features of the woodlands of Cook County."

C. Z. Nelson, Galesburg, "Studies in the North American *Opuntia.*"

Dr. Geo. D. Fuller, University of Chicago, "Soil as a limiting factor of forests in La Salle County, Illinois."

Dr. W. B. McDougal, University of Illinois, "Some mushrooms which are rare or have not previously been reported from Illinois."

Clarence Bonnell, Harrisburg Township High School, "The occurrence of a white form of *Tradescantia virginica.*"

PAPERS ON ZOOLOGY

Dr. Frank C. Baker, University of Illinois, "A mussel survey of the upper waters of the Vermilion River, with special reference to Salt Fork."

Professor T. L. Hankinson, Eastern State Normal School, Charleston, "Life history notes on Illinois fish."

Dr. H. J. Van Cleave, University of Illinois, "Preliminary survey of the Acanthocephala from fishes of the Illinois River."

Theodore H. Frison, University of Illinois, "Keys for the separation of the Bremidæ, or bumblebees of Illinois, and other notes."

Miss Marion J. Miller, Illinois College, "Observation of the Kentucky Cardinal."

Anne Wakely Jackson, Illinois College, "Bird songs."

A special illustrated address on Porto Rico was given by Dr. R. D. Salisbury, president of the academy, and one by Dr. Josephine Milligan, of Jacksonville, on the work of the Red Cross among the civilian population of France.

The officers elected for the ensuing year are the following: *President*—Dr. Henry B. Ward, of the University of Illinois; *Vice-president*—Dr. Geo. D. Fuller, of the University of Chicago; *Secretary*—J. L. Pricer, of the State Normal University, Normal; *Treasurer*—Dr. W. G. Waterman, of the Northwestern University.

J. L. Pricer,
Secretary

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CONTENTS

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METHODS OF SECURING BETTER COOPERATION BETWEEN GOVERNMENT AND LABORATORY ZOOLOGISTS IN THE SOLUTION OF PROBLEMS OF GENERAL OR NATIONAL IMPORTANCE[1]

Let us admit at once that government bureaus have great difficulty in getting men trained for their work. Let us go further, and admit that government bureaus have practically, except for certain fundamentals, to train their own men. Let us acknowledge also that the men in charge of the biological laboratories of the universities of the country are ready and anxious to train their men to be of the greatest possible service to the country, and that this readiness and this anxiety have been intensified by the great crisis through which we have been and are still passing.

How is this to be brought about? Plainly by a very perfect understanding and sympathy between the men in charge of the government bureaus and the men in charge of the university laboratories.

Although this suggestion has been made a number of times (I made it myself twenty years ago in an address before the American

[1] A symposium before the American Society of Zoologists, held at Baltimore on December 26, 1918, Professor C. E. McClung presiding, included papers and discussions as follows: Representing the Bureau of Entomology, Dr. L. O. Howard. Discussion by J. G. Needham, representing the Bureau of Fisheries, Dr. Hugh M. Smith. Discussion of Dr. H. B. Ward. Representing the Bureau of Animal Industry, Dr. B. H. Ransom. Discussion by Dr. Herbert Osborn. Representing the Bureau of Biological Survey, Dr. E. W. Nelson. Discussion by Dr. R. K. Nabours. Relation of the Council of National Defense and the National Research Council to the Advancement of Research, Dr. John C. Merriam.

Society of Naturalists at Baltimore), this present discussion is, I hope, an emphatic and practical beginning of a definite movement which will bring results. It is primarily, perhaps, for the government men to point out the needs. They are now assured of the warm desire to cooperate on the part of the university men, and it is only by the closest cooperation that the best results can be secured. This involves more than mere suggestions from the government to the universities. It should mean a thorough knowledge on the part of the heads of the university laboratories of the intimate nature of the problems being studied and of the methods which are being adopted to solve these problems. Such a knowledge as this can best be gained by personal contact with the workers, and such contact should be of such a nature as to bring about not only suggestions to the teachers as to the best methods of training their men for future government work but also suggestions from the trained minds of the teachers as to other directions or means of attacking the problems which the government is trying to solve.

It would be an ideal arrangement if every highly trained laboratory man in the principal universities could be made a collaborator of some government scientific bureau and could be permitted and encouraged at government expense to visit for a longer or shorter time the different field laboratories of the government working in lines in which he himself is working, and thus bring about the personal knowledge and personal contact necessary for both lines of suggestion. Such an arrangement in a large way is probably impractical at present, but it might be started in a small way and in individual cases and will probably become eventually a fixed and valuable policy.

And now as to teaching and the training of workers, I don't know whether as a rule teachers have kept positive and relative values clearly in their own minds and in the minds of their students. Do they point out plainly the practical utilizations of zoology? Do they show their students the whole of the field that is open to the trained investigator, and do they make their teaching as broadly attractive as possible? Have they made enough use of the great out-of-doors? Are they utilizing to the full the educational help of the motion picture?

In general, a man coming from a university to that branch of the government service with which I am connected should be fundamentally sound in botany, chemistry and physiology, and he should have an acquaintance with the principal foreign languages in which the results of important work are published.

There is need, as my colleagues who are to speak for other government bureaus will readily admit, for several different types of men in the service—men who have been trained for different kinds of work—and this should be borne in mind in considering the following suggestions.

We need more training in taxonomy, that basic branch of zoology upon which all other work rests.

We need an infinite amount of investigation in the different tropisms, in behavior, in all ecological lines, and, considering relative values, forms should be chosen for such studies from among those species which have an important economic rank or from among very closely related forms. In many cases enormous time has been comparatively wasted from the want of recognition of the importance of this point.

There should be careful training in the planning of experiments, in the interpretation of results, in the collation of suggestive results, and in the preparation of reports. The average man coming from a university is wofully lacking in the latter training, and gains it with slow progress after entering the government service.

As to cooperative work between the universities and the government laboratories, in addition to the training of men by the former for service in the latter, there is much that can be done aside from this training and the possible official collaboration of certain teachers with traveling privileges hinted at in a former paragraph.

Constant suggestions might be made from the government laboratories to teachers concerning the lines of work that might be taken up by advanced students in preparation for theses which would fit in with general investigations being carried on by the government. It is extraordinary that such suggestions have not been asked for by teachers, or that they have not been made in considerable number by government men engaged in zoological work. I am informed by Dr. Alsberg that such a policy exists in regard to chemical problems and that the Bureau of Chemistry often assigns practical research problems to university men who have the laboratory facilities and the time to devote to research.

This naturally suggests the research fellowships which are beginning to be founded in certain universities by certain industrial organizations, and with this in mind the thought arises: Might not the government itself found fellowships at universities for the investigation of certain problems in applied science?

The laboratories of the larger universities are fitted out with costly and extensive apparatus which while existing doubtless in some of the government laboratories, are not duplicated in any number in field laboratories. Such apparatus as hydrographic machines, respirometers, calorimeters and others belonging to the university should, by collaboration, be used in practical government investigations. An admirable example of this kind of cooperation is the elaborate work on the wintering of bees which was done a few years ago at the University of Pennsylvania in collaboration with the Bureau of Entomology.

There is much that might be considered in this general way, and there are many specific things that occur to me, but which it will be undesirable to take the time to advance at present. Expecting that the approximate soundness of what has been said will be admitted, it seems to me that a practical step towards putting the whole matter on a cooperative basis will be to organize a permanent committee of government men in Washington, to whom definite suggestions can be sent by university and government workers and who can discuss these suggestions, arrange them in practical form, and distribute them where they can do the most good. Such a committee would therefore be a clearing house for ideas, and its opinion as to the value of the ideas and the best and most practical way of carrying them out would carry weight. Perhaps there should be associated with this committee and as members of it certain strong men from nearby university zoological laboratories.

I welcome most heartily the movement which has brought about this symposium and which bids fair to have results of much importance.

L. O. Howard

The problems of national importance with which we are called upon to deal are doubtless those having to do with the biological needs of our species. These fall into three principal categories: Needs of food, needs of shelter, needs of defense.

These are the primary needs of all animals. Given proper physical conditions—suitable air, moisture, temperature, pressure, etc.—these are the matters in respect to which every species must make its own provision. Of these, food is the most insistent and everrecurrent need. Shelter is for our species a little different from that of other species, since it means for us clothing and housing of a very artificial sort. Defense also has grown different, though the categories of our natural enemies are the same. They are: (1) Enemies to be escaped, because of their superior powers; (2) enemies to be fought, there being a fighting chance to overcome them; (3) enemies to be dispersed, because individually insignificant; (4) enemies to be endured (at least until we have means for their control) because they are so small.

Invention has enabled us to cope with all our enemies save a few of the smallest of them. We have improved our fighting weapons until all the great beasts have been put

completely within our power, and our worst remaining enemies are those of our own species. The only needs of defense that Mother Nature imposed upon our species were needs of power to combat enemies of other species and to meet the rigors of our environment; all else is but a self-imposed burden.

I judge by the topics of this conference that it is the need of food that we are mainly called upon to consider. The conservation of food, through the control of insect destroyers of it, is a prime duty of Dr. Howard's bureau and of several others. So of food I shall speak. Years ago when writing a text-book of general biology, desiring to have said something when I got to the end of the first sentence, I wrote: "The primary demand of individual livelihood is for food;" and after a dozen or more years of subsequent reflection upon the subject, I think that that is about the most important biological statement I ever made.

Our species began by eating what Mother Nature provides ready made, as the animals eat. Such plant products as fruits, nuts, roots; such animal products as eggs and oysters, were at once available for consumption. But unlike the other species, we have vastly increased the range of our diet, first by the use of fire in cooking, and then by the care and cultivation of the more valuable food-producing species in agriculture. Thus the entire range of the world's organic food stuffs is becoming available for the use of our species, in a small part unmodified as in the beginning, in a larger part after milling and culinary treatment, and in by far the largest part, after several turnovers by biological agents. In this last direction we have made only a beginning. I regard it as the field most promising in results for future research.

Our food is fundamentally the same as that of animals, and many animals are competitors with us for the same supplies. Some of these animals, like rats and mice and cockroaches, having dietaries like our own and appreciating our shelter as well as our food stores, have gone all over the world with us and have become our permanent associates. Many others have settled in our fields where, by raising their food plants in mostly pure cultures, we have greatly improved the means of sustenance for them.

The pioneer when his fields became infested with pests could escape their competition for a time by opening new fields in another locality; but that was when land was plenty and men were few. Now, the land is filled. The people are here and must be fed. This is going to require that all the fields yield their full measure of increase every year, and that all that is raised be saved for human use. This then is one great national problem; to raise more food and to save what we raise from the ravage of competing species.

In the task of finding out the best means of accomplishing these needs, government and university biologists are colaborers. Their highest function, that of research, they have in common. They have, also, functions apart, that of the university being to train men for this work, and that of the government bureaus, to administer the work throughout the land. We are met here to consider the problem together, and to ask whether there are ways of making better progress through cooperation and mutual aid.

Dr. Howard's suggestions appear to be along two lines: Better training of men for the work; better facilities for exchange of experiences.

If the first seems to reflect on the training done in the universities, nevertheless it is a good suggestion and one that is always in order, and when it comes from so good a friend and so competent a critic of our work, accompanied by specific suggestions for improvement, it is more than welcome and we shall try to meet it. When he suggests in substance that we put the most important thing foremost, I am not sure that we will be able to agree with him or even with one another as to what is most important. It is important to give the student a good foundation in the fundamental sciences, for only on this may a superstructure of technical knowledge safely be reared. It is also necessary in this day of specialization to give as much

training as possible for particular lines of work. To the teachers of the fundamental sciences, the whole time of a college course seems inadequate for the first. To the specialist all the time seems required for the second. Both aims are proper aims but they are forever at variance. The course of study is always a compromise between the two; and the difficulties of making the compromise satisfactory grow with ever increasing knowledge. Yet human life is not appreciably lengthened, and the years that a youth may wholly devote to preparation for service are not increased. Probably some time may be gained for special training by more rigorous selection of materials for fundamental courses, by the limitation of the work of these to essentials, and by avoidance of duplication. This can be done and should be done.

Dr. Howard suggests that we give more time to taxonomy and ecology and less to physiology and genetics. This is a good suggestion. We are all out of balance. Some of our laboratories resemble up-to-date shops for quantity production of fabricated genetic hypotheses. Some of our publications make a prodigious effort to translate everything biological into terms of physiology and mechanism—an effort as labored as it is unnecessary and unprofitable. Why not let the facts speak for themselves? Our laboratories are full of fashions. They go from one extreme to another. In my high school days we learned systems of classification; in my college days we did nothing but dissecting; later came morphology and embryology, then experimental zoology, then genetics, and the devotees of each new subject have looked back upon the old with something like that disdain with which a debutante regards a last year's gown. Natural history and classification are perhaps long enough out of date, so that interest in them may again be revived. I hope so; for these are the phases of biology by means of which a youth is best oriented for more special work. Then, too, they are immensely practical. One has to deal with species, and must be able to recognize them; and all economic procedure is applied ecology.

As to the training of men for report making that Dr. Howard suggests, I am a bit more doubtful. There are reports and reports. For the making out of reports merely to comply with governmental red-tape, I do not care to train men. Experience is the only school for this. And as to the training needed for making reports of the results of investigation, it is often training in restraint that is most needed. I hope it is not training in the construction of imposing and impressive diagrams that Dr. Howard has in mind. I have seen some such at these meetings, built like a sky-scraper, and far harder to understand than the few simple facts they were intended to set forth and explain! I set but three requirements before students in my own laboratory: (1) Clear analysis of the subject matter, (2) simple drawings, (3) good English—and not too much of it.

After all, if Dr. Howard has to take men from the universities and train them on his job, I do not feel badly about it, nor wholly responsible. Indeed, if we in the universities do our best, as assuredly we will, I think this will always be so; and if it were not so I should know that Dr. Howard's work was dead, and making no further progress; for, faster than we can equip and organize our teaching to meet new needs, new methods will evolve and demands for help will spring up in unexpected places.

Now as to cooperation, Dr. Howard suggests that the government provide means whereby properly trained men from the university laboratories may visit the government field laboratories for the purpose of acquainting themselves with the work there going on. Nothing better could be devised to give that purpose and direction to our teaching that he desires. Nothing could do more to infuse new vigor into our work of research. It would result first of all in substituting for some of the puny problems of our laboratories of sickly forcing-house types, others of the robust field-grown type, to which a young man might give his time and labor without reserve, and without a question as to its usefulness and value. It would check the tendency

to congregate in a few popular marine laboratories, there to run and howl with the pack, and would lead to greater independence in our scientific spirit and work.

Over against this suggestion of something the government might well do, I would place a suggestion of something the universities might well do. In the interests of their own work and of keeping it abreast of the times, they might make provision for sending their investigators each year to meetings such as this one, and to all national meetings in the field of the sciences that they cultivate: I mean, pay their traveling expenses. It would cost comparatively little and would help to keep both men and institutions alive.

Such means of getting together would provide opportunities for the exchange of experience, for learning new methods and for getting help from fellow specialists.

After all, we need to realize that cooperation in research has its serious limitations. Real research is nearly always the work of individuals. Nature does not yield up her secrets to a crowd or even to a committee, but only to her humble devotee, when working alone and apart. When a man is found working at a problem for which he is well trained and well equipped and in which he has both faith and zeal, the best way to cooperate with that man is to let him alone and keep out of his road.

Cooperation is limited in advance to getting oriented, and getting equipped. But after a discovery of a fundamental nature has been made, then cooperation is needed to learn the limits of its application. Life is a complex of changing factors, and environment is a complex of instable conditions. A good method is often good only locally and under certain conditions. Especially in field work in entomology it needs to be tested out zone by zone and province by province; and the cooperation of many hands in many places is needed to find its limitations, and its true economic value.

Let us meet and exchange experiences. Progress in knowledge usually depends on our ability to take a hint from nature, as to where to look and what to look for: and the hint we may often obtain from the work of another. Betterment of methods oftenest grows out of comparison of results. Let me assure Dr. Howard that laboratory men are not unmindful of the limitations of laboratory methods, nor unwilling to go out in the field and acquaint themselves with the scientific problems the work of the bureau has raised, nor indisposed to do all they can to help solve them.

J. G. NEEDHAM

CORNELL UNIVERSITY

THE NATIONAL RESEARCH COUNCIL

ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL[1]

PREAMBLE

THE National Academy of Sciences, under the authority conferred upon it by its charter enacted by Congress, and approved by President Lincoln on March 3, 1863, and pursuant to the request expressed in an Executive Order made by President Wilson on May 11, 1918, hereto appended, adopts the following permanent organization for the National Research Council, to replace the temporary organization under which it has operated heretofore.

ARTICLE I.—PURPOSE

It shall be the purpose of the National Research Council to promote research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare, as expressed in the executive order of May 11, 1918.

ARTICLE II.—MEMBERSHIP

Section 1. The membership of the National Research Council shall be chosen with the view of rendering the Council an effective federation of the principal research agencies

[1] Approved by the National Academy of Sciences at its meeting on April 30, 1919.

in the United States concerned with the fields of science and technology named in article I.

Section 2. The council shall consist of (1) Representatives of national scientific and technical societies; (2) representatives of the government, as provided in the executive order; (3) representatives of other research organizations and other persons whose aid may advance the objects of the council.

ARTICLE III.—DIVISIONS

Section 1. The council shall be organized in divisions of two classes: (A) Divisions dealing with the more general relations and activities of the council; (B) divisions dealing with related branches of science and technology.

Section 2. The initial constitution of the divisions of the council shall be as follows: (A) Divisions of General Relations: (1) Government Division, (2) Division of Foreign Relations, (3) Division of States Relations, (4) Division of Educational Relations, (5) Division of Industrial Relations, (6) Research Information Service. (B) Divisions of Science and Technology: (7) Division of Physical Sciences, (8) Division of Engineering, (9) Division of Chemistry and Chemical Technology, (10) Division of Geology and Geography, (11) Division of Medical Sciences, (12) Division of Biology and Agriculture, (13) Division of Anthropology and Psychology.

Section 3. The number of divisions and the grouping of subjects in article III., section 2, may be modified by the executive board of the National Research Council.

Section 4. The Divisions of General Relations shall be organized by the Executive Board of the National Research Council (article IV., section 2).

Section 5. To secure the effective federation of the principle research agencies in the United States, provided for in article II., a majority of the members of each of the Divisions of Science and Technology shall consist of representatives of scientific and technical societies, chosen as provided for in article V., section 2. The other members of the Division shall be nominated by the executive committee of the division, approved by the executive board of the National Research Council, and appointed in accordance with article V., section 4.

Section 6. The divisions of the council, with the approval of the executive board, may establish sections and committees, any of which may include members chosen outside the membership of the council.

ARTICLE IV.—ADMINISTRATION

Section 1. The affairs of each division shall be administered by a chairman, a vice-chairman and an executive committee, of which the chairman and the vice-chairman shall be ex-officio members; all of whom shall be elected annually by the division and confirmed by the executive board.

Section 2. The affairs of the National Research Council shall be administered by an executive board, of which the officers of the Council, the president and home secretary of the National Academy of Sciences, the president of the American Association for the Advancement of Science, the chairmen and vice-chairmen of the Divisions of Science and Technology, and the chairmen of the Divisions of General Relations shall be ex-officio members. The executive board may elect additional members, not to exceed ten in number, who, if not already members of the National Research Council, shall be appointed thereto, in accordance with article V., section 4.

Section 3. The officers of the National Research Council shall consist of a chairman, one or more vice-chairmen, a secretary and a treasurer, who shall also serve as members and officers of the executive board of the council.

Section 4. The officers of the National Research Council, excepting the treasurer, shall be elected annually by the executive board. The treasurer of the National Academy of Sciences shall be ex-officio treasurer of the National Research Council.

Section 5. The duties of the officers of the council and of the divisions shall be fixed by the executive board.

ARTICLE V.—NOMINATIONS AND APPOINTMENTS

Section 1. The government bureaus, civil and military, to be represented in the government division, and the scientific and technical societies, to be represented in the Divisions of Science and Technology of the National Research Council, shall be determined by joint action of the council of the National Academy of Sciences and the executive board of the National Research Council.

Section 2. Representatives of scientific and technical societies shall be nominated by the societies, at the request of the executive board, and appointed by the president of the National Academy of Sciences to membership in the council and assigned to one of its divisions.

Section 3. The representatives of the governments shall be nominated by the president of the National Academy of Sciences after conferences with the secretaries of the departments concerned, and the names of those nominated shall be presented to the President of the United States for designation by him for service with the National Research Council.

Section 4. Other members of the council shall be nominated by the executive committees of the divisions, approved by the executive board, and appointed by the president of the National Academy of Sciences to membership and assigned to one of the divisions.

Section 5. Prior to the first annual meeting of the council following January 1, 1919, all divisions shall be organized by appointment of their members in accordance with article II. and article V., sections 1 to 4.

Section 6. As far as practicable one third of the original representatives of each scientific and technical society and approximately one third of the other original members of each of the divisions of science and technology shall serve for a term of three years; one third for a term of two years, and one third for a term of one year, their respective terms to be determined by lot. Each year thereafter, as the terms of members expire, their successors shall be appointed for a period of three years.

Section 7. The government representatives shall serve for periods of three years, unless they previously retire from the government office which they represent, in which case their successors shall be appointed for the unexpired term.

Section 8. As far as practicable a similar rotation shall be observed in the appointment of the members of the Divisions of General Relations.

ARTICLE VI.—MEETINGS

Section 1. The council shall hold one stated meeting, called the annual meeting, in April of each year, in the city of Washington, on a date to be fixed by the executive board. Other meetings of the council shall be held on call of the executive board.

Section 2. The executive board and each of the divisions shall hold an annual meeting, at which officers shall be elected, at the time and place of the annual meeting of the council, unless otherwise determined by the executive board, and such other meetings as may be required for the transaction of business.

Section 3. Joint meetings of the executive board of the National Research Council and the council of the National Academy of Sciences shall be held from time to time, to consider special requests from the government, the selection of organizations to be represented in the National Research Council, and other matters which, in the judgment of the president of the National Academy, require the attention of both bodies.

ARTICLE VII.—PUBLICATIONS AND REPORTS

Section 1. An annual report on the work of the National Research Council shall be presented by the chairman to the National Academy of Sciences, for submission to Congress in connection with the annual report of the president of the academy.

Section 2. Other publications of the National Research Council may include papers, bulletins, reports and memoirs, which may appear in the *Proceedings* or *Memoirs* of the

National Academy of Sciences, in the publications of other societies, in scientific journals, or in a separate series of the Research Council.

MEMBERSHIP OF DIVISIONS

Members of divisions of the National Research have been appointed as follows:

DIVISION OF PHYSICAL SCIENCES

Chairman: C. E. Mendenhall.

Acting Chairman until June 30: A. O. Leuschner.

Executive Committee: C. E. Mendenhall, *Chairman,* William Bowie, A. O. Leuschner, *Acting Chairman,* R. A. Millikan, H. N. Russell E. B. Wilson.

Representatives of Societies—American Astronomical Society: W. W. Campbell, H. N. Russell, Joel Stebbins. *American Physical Society:* H. A. Bumstead, William Duane, Irving Langmuir, Ernest Merritt, R. A. Millikan, E. B. Wilson. *American Mathematical Society:* E. W. Brown, L. E. Dickson, H. S. White.

Members at Large, nominated by the division: J. S. Ames, L. A. Bauer, William Bowie, Henry Crew, C. F. Marvin, Max Mason, M. I. Pupin, S. W. Stratton, A. Trowbridge.

DIVISION OF ENGINEERING

Chairman: Henry M. Howe.

Vice-chairman and acting chairman: Galen H. Clevenger.

Executive Committee: Henry H. Howe, *chairman,* Comfort A. Adams, Galen H. Clevenger, *vice-chairman,* D. S. Jacobus, E. G. Spilsbury.

Representatives of Societies—American Society of Mechanical Engineers: Arthur M. Greene, W. F. Goss,[1] D. S. Jacobus.[1] *American Institute of Electrical Engineers:* Comfort A. Adams, F. B. Jewett,[1] W. R. Whitney. *American Institute of Mining Engineers:* Hennon Jennings, Philip N. Moore, Joseph W. Richards.[1] *American Society of Civil Engineers:* Anson Marston, H. H. Porter,[1] George S. Webster. *American Society for Testing Materials:* A. A. Stevenson. *American Society of Illuminating Engineers:* Edward P. Hyde. *Western Society of Engineers:* Arthur N. Talbot. *Society of Automotive Engineers:* Charles F. Kettering.

Members at Large, nominated by the division: Henry M. Howe, Galen H. Clevenger, Edward Dean Adams,[1] John J. Carty, Gano Dunn, Van H. Manning, Charles F. Rand,[1] E. G. Spilsbury, Bradley Stoughton,[1] S. W. Stratton, Ambrose Swasey, William R. Walker.

[1] Member of Engineering Foundation.

DIVISION OF CHEMISTRY AND CHEMICAL TECHNOLOGY

Acting chairman until June 30: E. W. Washburn.

Chairman, July 1, 1919 to June 30, 1920: W. D. Bancroft.

Vice-chairman: Julius Stieglitz.

Executive Committee: E. W. Washburn, *Acting chairman,* W. D. Bancroft, *Chairman-elect,* Julius Stieglitz, *Vice-chairman,* A. B. Lamb, A. A. Noyes, C. L. Alsberg.

Representatives of Societies—American Chemical Society: C. L. Alsberg, W. D. Bancroft, C. G. Derick, J. M. Francis, E. C. Franklin, W. F. Hillebrand, John Johnston, Julius Stieglitz, J. E. Teeple. *American Electrochemical Society:* Colin G. Fink. *American Institute of Chemical Engineers:* Hugh K. Moore. *American Ceramic Society:* Albert V. Bleininger. *Members at large, nominated by the division:* C. H. Herty, G. A. Hulett, A. B. Lamb, A. A. Noyes, C. L. Parsons, E. W. Washburn.

DIVISION OF GEOLOGY AND GEOGRAPHY

Vice-chairman and acting chairman: E. B. Mathews.

Executive Committee: E. B. Mathews, *Vice-chairman,* Isaiah Bowman, A. H. Brooks, J. M. Clarke, N. M. Fenneman, David White.

Representative of Societies—Association of American Geographers: W. M. Davis, N. M. Fenneman, J. Russell Smith. *American Geographical Society:* Isaiah Bowman. *Geological Society of America:* J. M. Clarke, Whitman Cross, R. A. Daly, H. E. Gregory, A. C. Lawson. *Paleontological Society:* T. Wayland Vaughan. *National Geographical Society:* Gilbert Grosvenor.

Members at Large, nominated by the division: Ralph Arnold, Eliot Blackwelder, A. H. Brooks, A. L. Day, Ellsworth Huntington, Douglas W. Johnson, E. B. Mathews, R. A. F. Penrose, Jr., David White.

DIVISION OF BIOLOGY AND AGRICULTURE

Chairman: C. E. McClung.

Vice-chairman: L. R. Jones.

Executive Committee: C. E. McClung, *Chairman,* L. R. Jones, *Vice-chairman,* I. W. Bailey, F. R. Lillie, G. R. Lyman, H. F. Moore, A. F. Woods.

Representatives of Societies—American Society of Agronomy: Charles V. Piper. *American Society of Bacteriologists:* Samuel C. Prescott. *Botanical Society of America:* William Crocker, A. S. Jones. *Ecological Society of America:* W. M. Wheeler. *American Society of Economic Entomologists:* P. J. Parrott. *Society of American Foresters:* Barrington Moore. *American Genetics Association:* G. N. Collins. *American Society for Horticultural Science:* U. P. Hedrick. *American Phytopathological Society:* G. R. Lyman. *Society of American Zoologists:* M. F. Guyer, F. R. Lillie, G. H. Parker.

Members-at-large, nominated by the division: I. W. Bailey, B. E. Livingston, C. E. McClung, C. F. Marbut, A. G. Mayor, H. F. Moore, J. R. Murlin, W. Osgood, A. F. Woods.

RESEARCH FELLOWSHIPS

The National Research Council announces its first appointments to national research fellowships in physics and chemistry. The fellowships are supported by the Rockefeller Foundation and the object of the National Research Council in maintaining a system of research fellowships is to promote fundamental research in physics and chemistry primarily in educational institutions of the United States. Fellowships are awarded to persons who have demonstrated a high order of ability in research for the purpose of enabling them to conduct investigations at educational institutions which make adequate provision for research in physics or chemistry. The National Research Council has received approximately forty applications. The following initial appointments have been made:

In Chemistry

F. R. Bichowsky, of Washington, D. C., A.B. (Pomona, '12), Ph.D. (California, '16). Physical chemist at the geophysical laboratory of the Carnegie Institute of Washington since 1916. Mr. Bichowsky plans to conduct researches at the University of California.

Emmett K. Carver, of New York City, A.B. (Harvard, '14), Ph.D. (Harvard, '17). Formerly assistant to the director of the Wolcott Gibbs Memorial Laboratory at Harvard; captain, Chemical Warfare Service, U. S. A.

W. H. Rodebush, Ph.D. (California, '17), at present research chemist for the United States Industrial Alcohol Company, of Baltimore, Md. Mr. Rodebush will conduct researches at the University of California on A Study of the Specific Heats and Other Properties of Substances at Low Temperatures.

In Physics

Leonard B. Loeb, of New York City, B.S. (Chicago, '12), Ph.D. (Chicago, '16). Formerly assistant physicist at the Bureau of Standards, Washington, D. C.; lieutenant, Aviation Service, U. S. A. Mr. Loeb will conduct his researches at the University of Chicago.

Robert A. Patterson, of Bristol, Connecticut, A.B. (Yale, '11), Ph.D. (Yale, '15). Formerly instructor in physics at Yale University; major, Field Artillery, U. S. A.

George P. Paine, of Madison, Wisconsin, A.B. (Harvard, '05), Ph.D. (Wisconsin, '18). Instructor in engineering mathematics, University of Wisconsin. Mr. Paine will conduct his researches at Harvard University and at Blue Hill Meteorological Observatory.

It is expected that additional appointments will be announced in the near future. The members and acting members of the Research Fellowship Board are as follows: Wilder D. Bancroft, Henry A. Bumstead, Simon Flexner, George E. Hale, Elmer P. Kohler, A. O. Leuschner, Robert A. Millikan, Arthur A. Noyes, E. W. Washburn.

THE INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE[1]

The annual report of Director Raymond F. Bacon of the Mellon Institute of Industrial Research[2] records a general extension of the institute's activities during the past year.

[1] For previous reports on the status of the system of cooperation between science and industry in operation at the Mellon Institute, see Duncan, Science, N. S., Vol. XXXIX. (1914), 672; Bacon, *ibid.*, XLIII. (1916), 453; *ibid.*, XLV. (1917), 399; and Weidlein, *ibid.*, XLVII. (1918), 447.

[2] The full report is published in *J. Ind. Eng. Chem.*, 11, 371–374, 1919.

A LIST OF THE INDUSTRIAL FELLOWSHIPS IN OPERATION AT THE MELLON INSTITUTE ON MARCH 1, 1919

Numbers and Names of Industrial Fellowships	Industrial Fellows, Names and Degrees	Foundation Sums and Dates of Expiration
No. 117—window glass	(Fellow to be appointed).	$3,000 a year. Bonus: $2,000.
No. 127—collar	H. D. Clayton (B.A., Ohio State University).	$2,800 a year. June 14, 1919.
No. 129—illuminating glass	A. H. Stewart (B.A., Washington and Jefferson College).	$2,100 a year. October 1, 1919.
No. 145—soap	(Fellow to be appointed).	$2,000 a year.
No. 150—enameling	R. D. Cooke (M.S., University of Wisconsin).	$2,600 a year. April 1, 1919.
No. 151—leather belting	*P. G. McVetty* (M.E., Cornell University), Senior Fellow. R. H. Edson (B.A., Clark College).	$4,900 a year. April 1, 1919.
No. 152—refractories	*E. M. Howe* (M.S., University of Pittsburgh), senior fellow B. M. Burchfiel (B.A., Southwestern College). E. N. Jessop (B.S., University of Pittsburgh). S. M. Phelps (assistant).	$7,000 a year. May 1, 1919.
No. 153—canning	M. R. Daughters (M.A., University of Nebraska), (second fellow to be appointed).	$6,000 a year. May 1, 1919.
No. 154—paper	Howard Curtis (B.A., Washington and Jefferson College).	$2,175 a year. June 1, 1919.
No. 155—protected metals	J. H. Young (Ph.D., Ohio State University).	$3,000 a year. June 1, 1919.
No. 156—physiological research	K. K. Jones (M.S., Kansas State Agricultural College).	$4,000 a year. August 1, 1919.
No. 157—dental products	C. C. Vogt (Ph.D., Ohio State University).	$2,000 a year. July 1, 1919. Bonus: Royalty on sales.
No. 158—leather soling	C. B. Carter (Ph.D., University of North Carolina).	$3,500 a year. June 1, 1919.
No. 159—copper	C. L. Perkins (B.S., New Hampshire College). R. E. Sayre (M.S., University of Wisconsin).	$5,400 a year. July 1, 1919.
No. 160—oil	*W. F. Faragher* (Ph.D., University of Kansas), senior fellow. W. A. Gruse (Ph.D., University of Wisconsin).	$10,000 a year September 1, 1919. Bonus: $10,000.
No. 161—glass	R. R. Shively (Ph.D., University of Pittsburgh).	$4,000 a year. September 1, 1919.
No. 162—gas	*J. B. Garner* (Ph.D., University of Chicago), senior fellow. H. B. Heyn (B.S., University of Wisconsin).	$7,500 a year. September 15, 1919.
No. 163—aluminum	*E. O. Rhodes* (M.S., University of Kansas), senior fellow. R. B. Trusler (B.S., Syracuse University).	$6,500 a year. September 15, 1919.
No. 164—alloy	O. E. Harder (Ph.D., University of Illinois).	$3,500 a year. October 1, 1919.
No. 165—coffee	C. W. Trigg (B.S., University of Pittsburgh).	$2,250 a year. October 1, 1919. Bonus: 2 per cent. of gross profits.
No. 166—food container	F. W. Stockton (B.A., University of Kansas).	$5,000 a year. October 16, 1919.
No. 167—magnesia	M. S. Mason (M.S., University of Illinois). R. H. Heilman, assistant (University of Pittsburgh).	$6,000 a year. January 1, 1920.
No. 166—yeast	*Ruth Glasgow* (M.S., University of Illinois), senior fellow. Grace Glasgow (M.S., University of Illinois). G. S. Bratton (B.A., University of Tennessee). F. M. Hildebrandt (Ph.D., Johns Hopkins University). W. H. Randall, assistant (George Washington University).	$15,000 a year. November 1, 1919.

A LIST OF THE INDUSTRIAL FELLOWSHIPS IN OPERATION AT THE MELLON INSTITUTE ON MARCH 1, 1919
(*Continued*)

Numbers and Names of Industrial Fellowships	Industrial Fellows, Names and Degrees	Foundation Sums and Dates of Expiration
No. 169—copper	*G. A. Bragg* (B.S., University of Kansas), senior fellow. J. W. Schwab (B.S., University of Kansas).	$6,000 a year. November 1, 1919.
No. 170—household utilities	F. F. Rupert (Ph.D., Massachusetts Institute of Technology). E. R. Edson (B.A., Clark College).	$5,000 a year. November 1, 1919.
No. 171—asbestos	A. F. Shupp (Ph.D., University of Pittsburgh).	$3,500 a year. November 1, 1919.
No. 172—silicate	M. G. Babcock (M.S., Iowa State College).	$2,500 a year. December 1, 1919.
No. 173—fiber	J. D. Malcolmson (B.S., University of Kansas).	$3,000 a year. November 15, 1919.
No. 174—glycerine	R. K. Brodie (M.S., University of Chicago). Melvin DeGroote (B.Ch.E., Ohio State University).	$5,000 a year. November 15, 1919.
No. 175—light metals	P. V. Faragher (Ph.D., Massachusetts Institute of Technology).	$4,000 a year. December 1, 1919.
No. 176—fuel	J. G. Davidson (Ph.D., Columbia University).	$5,000 a year. January 1, 1920.
No. 177—toilet articles	(Fellow to be appointed.)	$3,500 a year.
No. 178—silverware	H. E. Peck (B.S., Clarkson Memorial College of Technology).	$2,500 a year. December 11, 1919.
No. 179—organic solvents	*L. M. Liddle* (Ph.D., Yale University), senior fellow. H. W. Greider (M.S., University of Kansas).	$5,600 a year. January 1, 1920.
No. 180—keratin	B. A. Stagner (Ph.D., University of Chicago).	$4,000 a year. January 1, 1920. Bonus: $5,000.
No. 181—synthetic resins	(Senior fellow to be appointed). A. E. Coxe (B.S., University of Chicago).	$5,000 a year. December 23, 1921.
No. 182—by-products recovery	Walther Riddle (Ph.D., University of Heidelberg). H. E. Gill, assistant (University of Pittsburgh).	$3,000 a year. January 1, 1920.
No. 183—A, organic synthesis	*G. O. Curme, Jr.* (Ph.D., University of Chicago), senior fellow. H. R. Curme (Ph.D., University of Pittsburgh). J. N. Compton (M.S., Columbia University). C. O. Young (Ph.D., University of Pittsburgh). E. W. Reid (M.S., University of Pittsburgh).	$32,400 a year. January 1, 1920.
No. 183—B, organic synthesis	*H. A. Morton* (Ph.D., University of Pittsburgh), senior fellow. C. J. Herrly (B.S., Pennsylvania State College).	
No. 184—coke	*F. W. Sperr, Jr.* (B.A., Ohio State University), advisory fellow. O. O. Malleis (M.S., University of Kansas). L. R. Office (B.S., Ohio State University). H. S. Davis (Ph.D., Harvard University).	$7,020 a year. January 1, 1920.
No. 185—insecticides	O. F. Hedenburg (Ph.D., University of Chicago).	$3,500 a year. January 1, 1920.
No. 186—fertilizer	H. H. Meyers (B.S., University of Pennsylvania).	$4,000 a year. January 5, 1920. Bonus: $5,000.
No. 187—glue	R. H. Bogue (M.S., Massachusetts Agricultural College).	$2,500 a year. January 5, 1920.
No. 188—distillation	David Drogin (M.S., University of Pittsburgh).	$3,000 a year. January 18, 1920.
No. 189—laundry	H. G. Elledge (M.S., University of Pittsburgh). Alice L. Wakefield, assistant (B.S., Margaret Morrison).	$5,000 a year. February 15, 1920.

A LIST OF THE INDUSTRIAL FELLOWSHIPS IN OPERATION AT THE MELLON INSTITUTE ON MARCH 1, 1919 (*Concluded*)

No. 190—bread	*H. A. Kohman* (Ph.D., University of Kansas), senior fellow. Roy Irvin (M.S., University of Kansas). R. J. Cross (B.A., Leland Stanford Jr. University).	$10,000 a year. March 1, 1921. Bonus: $10,000.
No. 191—fruit beverages	H. A. Noyes (M.S., Massachusetts Agricultural College).	$3,000 a year. March 1, 1920.

During the institute year March 1, 1918, to March 1, 1919, there was a marked growth in both the number of industrial fellowships in operation and the amounts subscribed for their support. At the present time there are 47 industrial fellowships, and 5 additional ones have been arranged for, to begin just as soon as the necessary laboratory space can be provided. Of these 47 industrial fellowships, 35 utilize the services of one research man on each fellowship (individual fellowships), while 12 have the intensive work, in each instance, of one or more investigators under the supervision of a senior fellow (multiple fellowships). Of these two types of industrial fellowships, 9 have been founded by associations of manufacturers and these association fellowships serve in all 2,700 company members.

The following table presents the number of industrial fellowships which have been founded in the institute from March to March of each year, 1911 to 1919; the number of industrial fellows (research chemists and engineers) who have been employed thereon; and the total amounts of money contributed for their maintenance by the industrial fellowship donors (industrialists and associations of manufacturers):

March to March	Number of Fellowships	Number of Fellows	Amounts Contributed
1911–1912	11	24	$ 39,700
1912–1913	16	30	54,300
1913–1914	21	37	78,400
1914–1915	21	32	61,200
1915–1916	36	63	126,800
1916–1917	42	65	149,100
1917–1918	42	64	172,000
1918–1919	47	77	238,245

The total amount of money contributed by industrial firms to the institute for the eight years ending March 1, 1919, was $919,745. During the eight years, the institute itself expended over $330,000 in taking care of overhead expenses—salaries of members of permanent staff and office force, maintenance of building, apparatus, etc.—in connection with the operation of the industrial fellowships. Besides this amount, the building and permanent equipment of the institute, which make it the most complete and modern industrial experiment station in the country, represent an investment of about $350,000.

The administration of the Mellon Institute is now constituted as follows: Raymond F. Bacon, Sc.D., director; Edward R. Weidlein, M.A., associate director; E. Ward Tillotson, Jr., Ph.D., assistant director; William A. Hamor, M.A., assistant director; David S. Pratt, Ph.D., assistant director; Harry S. Coleman, B.S., assistant director.

SCIENTIFIC EVENTS

MINERAL DEPOSITS IN THE UNITED STATES

THE Geological Survey has recently published as its Bulletin 660 its annual volume entitled "Contributions to Economic Geology (short papers and preliminary reports), 1917. Part I. Metals and Nonmetals Except Fuels." This bulletin contains 11 papers describing deposits of ores of iron, manganese, tin, antimony, lead, silver and gold in widely separated parts of the United States and deposits of greensand, clay, and strontianite. The shortage of manganese, which is used extensively in hardening steel, and the high prices resulting from its scarcity, caused the survey to examine undeveloped deposits in western Arkansas and in Shenandoah Valley, Va., the results of which are described in "Manganese Deposits of the Caddo Gap and De Queen quadrangles, Ark.," by H. D. Miser, and "Possibilities for Manganese Ore on Certain Un-

developed Tracts in the Shenandoah Valley, Va.," by D. F. Hewitt, G. W. Stose, F. J. Katz and H. D. Miser. The greensand deposits of the eastern United States are considered by G H. Ashley particularly with reference to their possible utilization as a source of potash, for their green color is due to their content of glauconite, a mineral that usually carries about 7 per cent. of potash, although the sands as a whole contain somewhat less of this useful alkali. An interesting paper on "Strontianit Deposits near Barstow, Cal.," by Adolph Knopf, forms part of the volume. Strontianite has been successfully used in the recovery of sugar from beet-sugar molasses, large quantities of the molasses being unavoidably produced in the manufacture of beet sugar. Among the mining districts described in this bulletin are the Cuyuna iron district, Minn., by E. C. Harder and A. W. Johnston; the Kings Mountain tin district, N. C. and S. C., by Arthur Keith and D. B. Sterrett; the northwestern part of the Garnet Range and the Dunklebery district, Mont., by J. T. Pardee; and the Arabia district, Nev., by Adolph Knopf.

The bulletin which consists of about 300 pages and contains a number of small maps and line illustrations, may be obtained on application to the Director, U. S. Geological Survey, Washington, D. C.

SUMMER BIOLOGICAL STATIONS

The University of Michigan will maintain its biological station for instruction and research for the eleventh session during the eight weeks from June 30 to August 22. This station is situated on the shores of Douglas Lake, near Pellston, Mich., about twenty miles northeast of Petoskey, in the famous summer playground of northern Michigan. It is, however, well isolated from the summer resorts and the resort crowds. The personnel of the teaching staff is as follows: In zoology, Professors La Rue and Welch, of the University of Michigan, Professor Frank Smith, of the University of Illinois, and Mr. Dayton Stoner, of the State University of Iowa; in botany, Professor Gates and Dr. Ehlers, of the University of Michigan, and Professor Quick, of De Pauw University. Courses are offered in entomology, ornithology, vertebrate zoology, ecology of invertebrate animals, systematic botany, plant ecology and plant anatomy, all but the last requiring a large amount of field work. Opportunity for investigation is offered to a limited number of investigators upon payment of nominal fees. For further information address George R. La Rue, director, the Biological Station, University of Michigan, Ann Arbor.

Dr. Raymond C. Osburn, head of the department of zoology and entomology in Ohio State University, has been appointed director of the Lake Laboratory. The 1919 session of the laboratory will be held from June 23 to August 2, a period of six weeks. The laboratory is now located at Put-in-Bay, Ohio, which is on an island in Lake Erie several miles from the mainland. It is easily reached by steamer from Cleveland, Sandusky and Detroit. Cooperation with the State Fish and Game Commission of Ohio during the 1918 session proved satisfactory to both the laboratory and the commission and the arrangement will be continued. A course on the fishes of Lake Erie will be given by Professor Osburn. Members of the staff will be Dr. F. H. Krecker, the acting director, Ohio State University, who will offer a course in animal ecology; Professor S. R. Williams, of Miami University, who is in charge of invertebrate morphology; Professor M. E. Stickney, of Denison University, who gives work in plant ecology, and Dr. Edna Mosher, who is in charge of entomology. Surveys made last summer showed that the region was exceptionally well suited to the requirements of the laboratory. The fauna and flora are abundant and offer a wide field for research along a number of important lines. Independent workers will be cordially welcomed and given laboratory accommodations without charge.

An illustrated booklet has recently been issued descriptive of the work and environment of the Iowa Lakeside Laboratory. This station was founded by alumni of the University of Iowa on Lake Okoboji in 1909.

Beginning with the summer of 1919 the work of the laboratory will be organized on a research basis, and only those prepared for independent work will be admitted. The laboratory will open June 23, continuing in session ten weeks and closing August 30. Any one interested in the work for the coming summer should address the director, Robert B. Wylie, of the University of Iowa, Iowa City, Iowa.

DISTINGUISHED SERVICE MEDALS

GENERAL PERSHING has awarded the Distinguished Service Medal to a number of medical officers including the following:

FRANCIS A. WINTER, Brigadier-General. As chief surgeon of the lines of communication, American Expeditionary Forces, from June to December, 1917, he organized medical units at the base ports and in camps in France. He established large supply depots from which medical supplies were distributed to the American Expeditionary Forces, and by keen foresight and administrative ability, made these supplies at all times available for our armies.

JOSEPH A. BLAKE, Colonel. As chief consultant for the district of Paris, and commanding officer of Red Cross Hospital, No. 2, he efficiently standardized surgical procedures especially in the recent methods of treating fractures. His remarkable talent has materially reduced the suffering and loss of life among our wounded.

GEORGE W. CRILE, Colonel. By his skill, researches and discoveries, he saved the lives of many of our wounded soldiers. His tireless efforts to devise new methods of treatment to prevent infection and surgical shock revolutionized Army surgery and met with the greatest success.

WILLIAM H. WILMER, Colonel. As surgeon in charge of medical research laboratories, air service, American Expeditionary Forces, since September, 1918, he has rendered most distinguished service. His thorough knowledge of the psychology of flying officers and the expert tests applied efficiently and intelligently under his direction have done much to decrease the number of accidents at the flying schools in France and have established standards and furnished indications which will be of inestimable value in all future work to determine the qualifications of pilots and observers. The data collected by him is an evidence of his ability, his painstaking care and of his thorough qualifications for the important work intrusted to him. The new methods, instruments and appliances devised under his direction for testing candidates for pilots and observers have attracted the attention and been the subject of enthusiastic comment by officers of the allied services, and will be one of great importance in promoting the safety and more rapid development of aerial navigation.

JOEL E. GOLDTHWAIT, Colonel. As a member of the medical corps he has, by his unusual foresight and organizing ability, made it possible to reclaim for duty thousands of men suffering from physical defects. He has thereby materially conserved for combat service a great number of men who would have been lost to the service.

THOMAS W. SALMON, Colonel. He has, by his constant tireless and conscientious work, as well as by his unusual judgment, done much to conserve manpower for active front line work. He was the first to demonstrate that war neurosis could be treated in advanced sanitary units with greater success than in base hospitals.

SCIENTIFIC NOTES AND NEWS

JOSEPH BARRELL, professor of structural geology at Yale University, died on May 4 from pneumonia and spinal meningitis, aged forty-nine years.

THE National Research Council announces the appointment of James Rowland Angell, dean of the faculties, and professor of psychology in the University of Chicago, as chairman of the council for the year commencing July 1, 1919. Dr. Angell succeeds Dr. George E. Hale, director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington, who has directed the affairs of the council during the war, and who resigned as chairman on April 30, to return to California. Dr. John C. Merriam, professor of paleontology in the University of California, who has been acting chairman of the council at various times, will direct its affairs until Dr. Angell assumes office in July.

AT a meeting of the Franklin Institute at Philadelphia on May 21, the presentation of the Franklin Medals will be made to Sir James Dewar, the distinguished English chemist, and to Major-General George Owen Squier, of the

United States Army. Major Squier will give an address on "Some aspects of the Signal Corps in the World War." The address will be illustrated by still and moving pictures showing signal corps activities in France, and a limited number of signal corps communication devices will be exhibited.

Dr. Albert Calmette, former director of the Institut Pasteur at Lille, now subdirector of the Institut Pasteur at Paris, has been elected an active member of the section on public hygiene and legal medicine of the Paris Academy of Medicine.

Dr. Archibald P. Knight, for twenty-seven years professor of physiology in Queen's University, Kingston, Ontario, plans to tender his resignation, but will retain his position until a successor is appointed.

Professor Dugald C. Jackson, of the Massachusetts Institute of Technology, has returned from France and has been discharged from the Army.

Dr. Tamiji Kawamura, of the Imperial University, Kyoto, Japan, author of a work on Japanese fresh-water biology, is spending the spring quarter in the department of zoology of the University of Illinois, studying the methods and equipment of animal ecology in the laboratory of Professor V. E. Shelford.

Dr. Joseph E. Pogue, formerly associate professor of geology and mineralogy in Northwestern University, has terminated his duties as assisting director in technical matters, Bureau of Oil Conservation, Oil Division, U. S. Fuel Administration, and accepted the appointment of curator in the Division of Mineral Technology, U. S. National Museum, where he will carry on educational work and investigations in industrial economics with special reference to the mineral industries.

Forrest E. Kempton, who took his Ph.D. degree at Illinois last spring and who was employed as plant pathologist in the Porto Rico Agriculture Experiment Station during part of the past year, is now employed by the U. S. Department of Agriculture Office of Cereal Investigations at the University of Illinois in connection with Barberry eradication.

J. B. Norton, of the Bureau of Plant Industry, who has been appointed agricultural explorer in the Office of Foreign Seed and Plant Introduction, has left Washington on an expedition to China.

Mr. M. B. Long, of the gas laboratory of the Bureau of Standards, has resigned in order to accept a position in the research laboratory of the Western Electric Company, in New York City.

Wishing to establish a Pasteur Institute, the government of Nicaragua has asked the Mexican government to send, at its expense, a person to establish one at Managua. In compliance with this request, the Mexican authorities have intrusted Dr. G. Leal with this duty, and he will depart shortly with the necessary personnel and equipment. As a courtesy to a sister republic, the Mexican government will bear the expenses connected with the trip.

The board of trustees of the American Medical Association has elected to the editorial staff of the *Archives of Internal Medicine,* Dr. George Dock, St. Louis; to the editorial staff of the *American Journal of Diseases of Children,* Dr. L. Emmett Holt, New York, and Dr. H. F. Helmholz, vice Dr. Frank Churchill, resigned because of removal from Chicago; on the Council of Pharmacy and Chemistry, Drs. C. L. Alsberg, Washington, D. C., Henry Kraemer, Ann Arbor, Mich., and John Howland, Baltimore, each to serve for five years; and Dr. W. W. Palmer, New York, to fill the vacancy caused by the death of Dr. J. W. Long, for a term extending to 1922.

At the recent meeting of the American Association of Anatomists, held in Pittsburgh, the following resolution was introduced and unanimously adopted: "The American Association of Anatomists expresses to Professor J. McKeen Cattell its grateful appreciation of the ability and unfailing devotion to scientific progress shown in his editorship of Science and other scientific journals, which, while serving other broader purposes, have been so often of direct benefit to anatomists."

DR. LIBERTY HYDE BAILEY, of Cornell University, will deliver the commencement address at the Kansas State Agricultural College.

THE Silvanus Thompson Memorial Lecture of the British Röntgen Society was delivered by Professor W. M. Bayliss, at the Royal Society of Medicine on May 6.

WILLIAM H. HALE, former superintendent of public baths of the City of New York, died on May 2, at the age of seventy-nine years. Dr. Hale became a member of the American Association for the Advancement of Science in 1874 and was a constant attendant at its meetings which he reported for journals and the press.

THE professor of physiology of the School of Medicine of the University of Buenos Aires, Dr. H. G. Piñero, died recently at Mar del Plata.

MR. GEORGE EASTMAN, president of the Eastman Kodak Company, has provided the Dental Dispensary at Rochester, N. Y., with an endowment of $1,000,000. The object of the institution is to provide dental work for the city's school children.

THE third Tuberculosis Sanitorium of the Virginia State Board of Health is now being designed. It will be situated at Charlottesville. In conducting it the State Board of Health will affiliate with the Medical School of the University of Virginia. According to the plan the students from the school and the nurses from the University Hospital Training School will have regular periods of service in the sanatorium. The sanatorium with one hundred beds or more will open next autumn.

THE Utah Experiment Station has received a special $20,000 appropriation from the state legislature for experimental work on underground water development. Investigations conducted by the Experiment Station and the U. S. Department of Agriculture show that vast areas of land in the southwestern part of the state contain sufficient underground water for irrigation. The experimental work to be done under this appropriation will be to determine the best type of well and equipment for various sections of the state. One well is now being driven in Iron County and others will be started in different sections of the state soon.

EPSILON chapter of Sigma Gamma Epsilon has been installed recently at the University of Missouri. This is a professional fraternity for those in geology, mining and metallurgy.

M. ALBERT SARRAUT, governor-general of Indo-China, recently announced the establishment of a scientific institute at Saigon, to study the development and utilization of the products of the soil and of the water of Indo-China. An inventory will be made of the natural resources of Indo-China, and the institute will aim to exploit them properly by means of laboratory studies, experimental research and scientific explorations.

THE *Journal* of the American Medical Association states that the National Association for the Study of Tuberculosis has recently granted $10,000 for an exhaustive scientific study to be made in Baltimore of the underlying causes of tuberculosis, under the direction of a committee consisting of Dr. Henry Barton Jacobs, Baltimore, president of the Maryland Association for the Study and Prevention of Tuberculosis; Dr. Raymond Pearl, professor of biometry and vital statistics in the School of Hygiene and Public Health, Johns Hopkins University, and Dr. William T. Howard, Baltimore, assistant commissioner of health. The grant is intended to defray the expense of the investigation and study for a year and the start will be made as soon as the necessary force of investigators can be organized. Baltimore city makes an annual appropriation of $30,000 to the health department for its tuberculosis work, and yet little progress has been made toward the reduction of the death rate. This is because the department has been unable to make its investigation as far reaching and as effective as the officials in charge have felt that the situation demanded.

THROUGH the aid of a grant made by the Research Committee of the American Medical Association, Roy L. Moodie, assistant professor of anatomy in the University of Illinois, re-

cently spent three weeks studying evidences of paleopathology in the principal paleontological museums of the eastern cities. The result is a number of observations which it is hoped will be of assistance in an understanding of ancient diseases. It was found, for instance, that the coalescence of the vertebræ of the huge dinosaurs is caused by the lesions of *Spondylitis deformans,* a common result of disease among Pleistocene vertebrates, in the ancient Egyptians and in modern man, and not previously known to occur before the Miocene. A large, fractured humerus of a Cretaceous dinosaur presents an interesting subperiosteal abscess, which is of considerable interest in connection with the study of comminuted fractures of limb bones in certain victims of the recent war.

Miss Maud Margaret Gibson has placed in the hands of the Royal Society of Medicine a sum of money sufficient to provide a scholarship of the yearly value of about £250, in memory of her father, the late Mr. William Gibson of Melbourne, Australia. The scholarship will be awarded from time to time to qualified medical women who are subjects of the British Empire. It is tenable for a period of two years, but may in special circumstances be extended to a third year.

UNIVERSITY AND EDUCATIONAL NEWS

The trustees of Wesleyan University have decided to start a campaign to secure an additional endowment of $2,000,000 for the university. The trustees have voted to make substantial increases in salaries of members of the faculty.

Queen's University, Kingston, Ontario, reports that an additional endowment of $1,000,000 has been received for the general purposes of the university. It is proposed that several more full-time professors will be secured and the departments of physiology, bacteriology and public health will be developed. A fund of $200,000 is also available to be expended in the reconstruction of the hospital.

At the University of Virginia, the school of analytical and industrial chemistry and the school of chemistry have been merged in one. Its affairs will be managed by a committee of the chemical faculty. The following new appointments are announced: Dr. Graham Edgar, of the National Research Council, with the rank of professor, and Mr. J. H. Yoe, of the Chemical Warfare Service, with the rank of adjunct professor. The staff of assistants has been enlarged considerably. Five new research fellowships have been established by the board of visitors. Applications for these should be filed with Dr. George L. Carter, secretary of the chemical faculty.

Professor Edward C. Schneider (Yale, '01), of Colorado College, has been elected head of the department of biology at Wesleyan University.

Dr. M. G. Gaba, of Cornell University, has been appointed associate professor of mathematics at the University of Nebraska.

Colonel William Darrach has been appointed dean of the College of Physicians and Surgeons by the trustees of Columbia University. He succeeds Dr. Samuel W. Lambert, whose resignation takes effect on July 1. Appointments and promotions at the college are announced as follows: William E. Studdiford, M.D., professor of obstetrics and gynecology, to succeed the late Dr. Edwin B. Cragin; Allen O. Whipple, M.D., now associate in surgery, to be assistant professor of pathology; Benjamin P. Farrell, instructor in orthopedic surgery, to be assistant professor in the same branch; Louis Cassamajor, associate professor of neurology, to be professor of neurology; Oliver S. Strong, Ph.D., assistant professor of neurology, to be associate professor of neurology.

DISCUSSION AND CORRESPONDENCE

AN IMMUNE VARIETY OF SUGAR CANE

Several years ago a serious disease of sugar cane appeared in Porto Rico. Owing to certain characters exhibited by this disease it was designated as the mottling disease of sugar cane (sometimes called mosaic). It may

be identical with the yellow stripe disease prevalent in Java and some other cane countries. At the request of the Porto Rican authorities the U. S. Department of Agriculture entered into cooperation with the insular and federal stations on the island, and Professor F. S. Earle, of the Office of Sugar-Plant Investigations, Bureau of Plant Industry, was detailed to take up the cooperative work in Porto Rico in August, 1918.

Among other lines of investigation Professor Earle studied very closely the sugar cane varieties growing in Porto Rico. He noted that among about twenty varieties growing at the federal station at Mayaguez there was one Japanese variety (Kavangire) showed no sign of the mottling disease, while all the other varieties there were more or less seriously affected. In order to carry this study further Professor Earle, through the kind cooperation of Russell & Co., inaugurated an experiment with ninety varieties of cane on their Santa Rita Estate. These varieties were planted and grown under the personal supervision of Russell & Co.'s cane planting expert, Mr. H. Bourne of Barbados. Single rows of cane were planted of the varieties to be tested, and every third row was planted with diseased seed of the Rayada variety (ribbon cane). In this way each variety was uniformly and completely exposed to the infection.

The first planting of the ninety varieties was made on October 1, 1918. Two and one half months later Mr. Bourne reported that all of the varieties except the Kavangire showed the mottling disease, the infection running from 9 per cent. to 96 per cent. This variety has remained free from disease to date, March, 1919, and shows every indication thus far of being immune to the mottling disease.

On January 29 of this year Professor Earle made a careful study of the experiment and found about half of the other varieties in this experiment showing an infection of fully 100 per cent., and in only two cases was it as low as 50 per cent. The degree of infection, however, was decidedly marked in different varieties, a few of them showing the disease but slightly, indicating that they are resistant though not immune, with the exception of the one variety Kavangire which appears to be entirely immune. In three or four of the least infected kinds close observation is necessary to detect the disease, the only evidence being very faint "watered silk" discolorations. Professor Earle has observed the Kavangire fully matured on the federal station at Mayaguez and in other localities, and in all of the localities in Porto Rico where it is growing it is entirely free from the mottling disease whether the plants are young shoots or mature canes.

The Kavangire cane is tall-growing and very slender, while the Porto Rican planter prefers a thick cane, because it appears to be a better yielder and is handled at less expense. However, the yield of the Kavangire under some conditions at least compares favorably with other varieties, and very greatly exceeding them in some cases. Director May reports a yield at the rate of 70 tons per acre on the Mayaguez plot. No analyses of the Kavangire variety, as grown in Porto Rico, are available, but according to some reports from other countries where it is grown it varies from 14.38 per cent. sucrose to 16.85 per cent. sucrose, while its purity coefficient varies from 84.6 to 89.67.

The Kavangire cane was imported into Porto Rico from the Argentine a few years ago by Mr. May, director of the Federal Experiment Station at Mayaguez. In Argentine it has been planted quite largely on a commercial scale indicating that it is satisfactory from the standpoint of sugar production. It requires a long season for maturity, and for this reason has not been recommended for general planting in Argentine. The sugar per acre is the crucial test, and in this respect the Kavangire generally stands near the top, so far as available records indicate.

After reviewing the available literature in regard to Kavangire Professor Earle raises the practical question as to whether or not Kavangire can be successfully used for general planting in Porto Rico. If it can and it retains its immune characteristic the question of combating the mottling disease is solved.

This question of the practicability of using the Kavangire is now under consideration by Professor Earle and his co-workers in Pórto Rico, and at the same time further observations will be made upon the immunity of this variety to the mottling disease. Unfortunately, the available supply of plant cane of Kavangire in Porto Rico is limited. It will take a number of years to propagate enough of this variety to make it available for general planting. In the meantime its adaptability to the Pórto Rican climatic and labor conditions will be determined. It appears to be a strong ratooner and to have considerable resistance to root disease, borer and stem rot. If these indications prove true Kavangire should enable the grower to keep his fields in profitable production longer without replanting than is possible with the varieties now in general use. This will reduce the cost of production, even though the habit of growth and quality of the cane should make it a somewhat more expensive variety to handle and to mill.

C. O. Townsend

U. S. Department of Agriculture

THE USE OF POISON GAS

To the Editor of Science: In regard to the article on "Poison Gases" by Major West, in your issue of May 2, 1919, the statement on p. 415 that at the Hague Conference of 1899 "the governments represented—and all the warring powers of the present great conflict were represented—pledged themselves not to use any projectiles whose only object was to give out suffocating or poisonous gases" is not correct. Twenty-six nations voted on the question, all but two being in the affirmative. The dissenting two were Great Britain and the United States. At the conference of 1907, Great Britain gave way and signed, but the United States refused. The reasons for the action of the United States are set forth clearly and, in my opinion, unanswerably by Admiral Mahan, the leader of the U. S. delegation, in a formal statement that he made on the occasion.

Henry Leffmann

Philadelphia, Pa.

SCIENTIFIC BOOKS

RENAISSANCE ANATOMY

Among the interesting papers published in "Studies in the History and Method of Science," edited by Charles Singer, and printed in Oxford by the Clarendon Press, 1917, is an important contribution of fundamental interest to students of the history of anatomy. The entire series of essays has been previously reviewed by Dr. Charles Dana[1] and we may confine our attention to Dr. Singer's "Study in Early Renaissance Anatomy," which occupies 84 pages of the book.

This study is subdivided:

I. Anatomy in the Fourteenth and Fifteenth Centuries.
II. Bolognese Works on Anatomy.
III. Hieronymo Manfredi, Professor at Bologna, 1463–93.
IV. The Manuscript *Anatomy* of Manfredi.
V. Translation of selected Passages from the Anothomia, with Commentary.
 (*a*) The Brain, Cranial Nerves, etc.
 (*b*) The Eye.
 (*c*) The Heart.
 Italian Text of the Anothomia.

There is little that is new in the first two sections, although there is much interesting material, accompanied by a wealth of bibliographic details which will save the worker in anatomical history much time and labor. The discussion is interesting and instructive; the illustrations, which are well reproduced, having been chosen from the works of such early writers as Henri de Mondeville (1314), Bartholomæus Anglicus (1482), Guy de Chauliac (1430?), Mondina (1493), Ketham (1495) and many other writers. Many of these illustrations have been previously given by Locy,[2] Sudhoff,[3] Choulant[4] and others.

[1] *Annals of Medical History,* I., no. 4, 1917 (issued February, 1919).

[2] "Anatomical Illustrations before Vesalius," *Jour. Morphol.*, 1911, XXII., no. 4.

[3] "Ein Beitrag zur Geschichte der Anatomie im Mittelalter," Leipzig, 1908.

[4] "Geschichte der anatomischen Abbildungen," Leipzig, 1852.

He refers in an interesting way to the tangled triangle between Leonardo da Vinci, Vesalius and Marc Antonio della Torre (1473–1506) which has been discussed extensively by McMurrich, Forster and others. Singer speaks of the "projected treatise of Marcantonio della Torre" which was to be prepared in conjunction with Leonardo, giving an interesting reference[5] to support his conclusion. Elsewhere he says: "Leonardo da Vinci's . . . anatomical researches were without influence, and remained long unnoticed," thus casting doubt on the supposition that these illustrations had influenced the work of Vesalius.

The short biographical sketch of Hieronymo Manfredi (1430–1493) is without particular interest and is doubtless duplicated in all essentials many times in the biographical sketches given in the "Biographie Médicale" and in the biographical dictionary of Gurlt and Hirsch which is largely based in the "Biographie Médicale."

Manfredi's anatomical views were modified by the astrological learning so prominent in Bologna at that time. The matter of greatest interest about his "Anothomia" however is that it represents the breaking away from the old Galenic anatomy, which was based on calves, dogs and other mammals, and applied without question to man. Manfredi's anatomy, while only a compilation, it is true, is yet based on a careful study of many writers. "It is in the main a rearranged and on the whole improved Mondino, but amplified by reference to translations from Galen, Rhazes, Haly Abbas and Avicenna."

Perhaps other writers were also used. It is not an original work, not yet a piece of research, although he had confirmed some of his descriptions by actual dissection. However, "It is perhaps the first complete treatise on its subject written originally in the vernacular," and represents anatomy as taught at Bologna at the end of the fifteenth century.

The translations of portions of the text, made by A. Mildred Westland, are interesting and instructive. Manfredi's discussion of the scalp, skull and meninges reads remarkably like a modern text-book of anatomy, the medieval terms *almochatim* and *lauda* being no worse than those of the BNA.

It may be interesting to give Manfredi's discussion of the chorioid plexus, which recalls, in a way the ideas held later by Descartes and Swedenborg, concerning the pineal body.

> To the side . . . is another thing like a subterranean worm, red as blood, yet tethered by certain ligaments and nervelets. And this worm when it lengthens itself closes these passages, and thus blocks the path between the first ventricle and the second. Nature has wrought it thus, so that when a man wills he may cease from cogitation and thought; and similarly when, on the other hand, he would think and contemplate, this worm contracts itself again and opens these passages and thus frees the way between one ventricle and another.

Manfredi gives the customary six cranial nerves, all that were known to the ancients. His discussion of the anatomy of the eye shows the strong influence of the Arabians who were excellent ophthalmologists, while his description of the heart follows closely that of Mondino.

In the opinion of the reviewer there have been few studies of more fundamental importance to the study of anatomical history than the present one by Dr. Singer. Sudhoff's study already referred to, the studies of Stieda, Toply and Jastrow on the "Beginnings of Anatomy" among the ancient Chaldeans, Babylonians and Romans are to be mentioned in this connection. Important contributions to anatomical history are difficult to produce, since it requires great linguistic ability, access to large collections of manuscripts and books, and some knowledge of anatomical structure. Such a combination, rare and difficult as it is, is found in the person of Dr. Charles Singer who is doing notable work in the advancement of knowledge of ancient medical literature through

[5] G. Cervetto, "Di alcuni illustri anatomici italiani del decimoquinto secolo," p. 46, Verona, 1842.

the publications at Oxford University, and in the pages of the *Annals of Medical History*.

Roy L. Moodie

University of Illinois,
College of Medicine

SPECIAL ARTICLES

NOTES ON CERTAIN CONGLOMERATIC STRUCTURES IN LIMESTONES IN CENTRAL PENNSYLVANIA

The following notes may be of value to those interested in the origin of limestone conglomerates in the Nittany valley, Pennsylvania.

Last summer while collecting extensively from the Stonehenge and Axemann limestones, fossiliferous members of the Beekmantown series, in the Bellefonte quadrangle the writer found repeated occurrences of fossils in the conglomeratic, or pseudo-conglomeratic beds. In some cases the fossils were sparingly disseminated among structures prevailingly conglomeratic and apparently of inorganic origin. In other instances fossil layers themselves assumed a conglomeratic appearance in cross-section, especially if slightly weathered. It was often impossible to determine in the field whether a structure, apparently conglomeratic, owed its superficial appearance to a strictly inorganic origin or rather to an assemblage of fossils in a more or less clastic fashion. Gradually the impression grew upon the observer that fossils worked over mechanically in some way prior to burial formed the basis of some of the so-called limestone conglomerates. Anent this possible method of formation the following observation is offered for what it is worth.

Several years ago the writer had occasion to collect fossils from the Warrior limestone (Buffalo Run limestone of Moore and Walcott) of Upper Cambrian age and found one outcrop which could be interpreted as the result of the mechanical breaking up of an organism. A small reef or cluster of *Cryptozoon*, seen in cross-section, appeared broken or flaked off in such a manner that the cemented rubble much resembled "edgewise" conglomerate. The area on the rock surface was small, but the occurrence is deemed significant.

Caution should be used by the field worker in interpreting probable conglomeratic structures in these limestones, as a cross-sectional view alone may be misleading unless the possibility of fossils is constantly kept in mind.

The paper by Mr. Richard M. Field[1] on these obscure structures deserves commendation. His many field observations and summary of previous literature render the work a distant contribution to knowledge whether or not one agrees with his theory of origin. The reader is referred to this paper for a full treatment of the subject.

Harry N. Eaton

Syracuse University

MINUTES OF THE COMMITTEE ON POLICY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Committee on Policy met on Monday, April 28, 1919, at 5 P.M., at the Cosmos Club, with Mr. Nichols in the chair, and Messrs. Woodward, Merriam, Humphreys, MacDougal, Cattell, Noyes, Ward and Howard also present.

On motion, Professor Dimon Kellogg, of Columbia, Mo., was elected to membership, made a fellow and, on nomination from the sectional committee of Section A, was elected vice-president and chairman of that section.

On motion, Dr. David Jayne Hill, was elected to membership, made a fellow and, on nomination from the sectional committee of Section I, was elected vice-president and chairman of that section.

On motion, Dr. C. Kenneth Leith, of Madison, having been nominated by the sectional committee of Section E, was elected as vice-president and chairman of that section.

On motion, A. S. Langsdorf, of Washington University, was elected as secretary of the council in place of Dr. J. F. Abbott, resigned.

[1] "A Preliminary Paper on the Origin and Classification of Intraformational Conglomerates and Breccias," Richard M. Field, *Ottawa Naturalist*, vol. 30, nos. 2–6, May–Sept., 1916, pp. 29–36, 47–52, 58–66.

A communication from Dr. Felix Neumann, of the Surgeon General's Library, suggesting a change in the last constitution in the name of Section K from Historical and Philological Sciences to History of Science was read, and, on motion, the secretary was instructed to inform Dr. Neumann that this idea could be embodied in an amendment to the constitution to be submitted at the St. Louis meeting, if desirable, or that members interested in the history of science could form a sub-section of Section K provided the name as previously recommended for the section should be adopted.

The following fellows were elected as honorary fellows emeritus under the terms of the Jane M. Smith Fund: Charles Frederick Chandler, Edward Williams Morley, William North Rice and Albert Henry Tuttle.

On motion, the treasurer was authorized to invest two thousand dollars in Victory Liberty Notes.

Reports of progress with regard to the proposed popular journal were made by Mr. Humphreys and Mr. Noyes. After a lengthy discussion on the proposal for a new scientific journal under the partial auspices of the American Association for the Advancement of Science, it was agreed it would be equitable to enter into arrangements provided that SCIENCE be offered to members for the three dollar fee; that the new popular journal or *The Scientific Monthly* be offered for four dollars; that SCIENCE and the new popular journal be offered for six dollars, and that all three publications be offered for nine dollars, and that SCIENCE be underwritten for its circulation through the American Association for the Advancement of Science on the amount of its subscriptions at the time of the establishment of the new journal; or that SCIENCE be paid fifty cents for each individual subscription between the actual subscriptions and the circulation at the time mentioned, the same to be deducted from the amount paid by the association to the new journal.

Dr. Ward reported from the committee on state and local academies, giving the results of preliminary negotiations with three state academies.

On motion, it was resolved that state and city academies of science may become associated or affiliated with the association by paying to the association only two dollars and fifty cents for each member, retaining fifty cents of the association fee for the use of the academy, and the entrance fee of the association of five dollars shall be remitted in such cases.

Mr. Cattell made a progress report with regard to the National Education Association.

On motion, Messrs. MacDougal, Coulter and B. M. Duggar were appointed a special committee to confer with the secretaries of societies of botanical interests which meet with the association to consider the coordination of the efforts of such societies.

On motion, the opinion of the committee on policy was expressed that, when the new journal on popular science is established, the entrance fee of the association should be remitted for one year.

At 10.30 P.M., the committee adjourned.

L. O. HOWARD,
Permanent Secretary

THE UTAH ACADEMY OF SCIENCES

THE twelfth annual convention of the Utah Academy of Sciences was held at Salt Lake City, April 4 and 5, 1919, in the physics lecture room of the University of Utah.

In all, three sessions were held—the first beginning at 8 o'clock Friday evening, the second at 9:30 o'clock Saturday morning, and the closing session at 2 o'clock Saturday afternoon.

At the business meeting Saturday afternoon, five members were elected to fellowship as follows: Dr. M. C. Merrill, Dr. Willard Gardner, Harold R. Hagan and Tracy H. Abell, of the Utah Agricultural College, Dr. Joseph F. Merrill, of the University of Utah.

The following persons were elected to membership in the Academy: Professor A. L. Beeley and Professor LeRoy Cowles, of the University of Utah, D. W. Pittman, of the Utah Agricultural College, Mark Anderson, of the U. S. Forestry Service, and Andrew Lee Christensen, Salt Lake City.

Dr. W. C. Ebaugh, formerly head of the department of chemistry at the University of Utah, having permanently removed from the state, was transferred to associate membership.

The constitution was amended in several particulars relating principally to the admission of new members. The office of corresponding secretary was created.

The following officers were elected for the ensuing year: *President*—Dr. Orin Tugman, University of Utah; *First Vice-president*—C. F. Korstian, U. S. Forestry Service, Ogden, Utah; *Second Vice-president*—Dr. Frank L. West, Utah Agricultural College, Logan; *Permanent Secretary-Treasurer*—A. O. Garrett, East High School, Salt Lake City; *Corresponding Secretary*—C. Arthur Smith, East High School, Salt Lake City; *Councillors-at-large*—Dr. W. D. Bonner, U. of U., Salt Lake City; Professor Hyrum Schneider, U. of U., Salt Lake City, and Dr. Newton Miller, U. of U., Salt Lake City.

The following papers were read at the convention:

Harold R. Hagan, Utah Agricultural College, Logan, "A history of entomology to 1800."

Mark Anderson, Forest Service, Ogden, "Detection of overgrazing by indicator plants."

Professor A. L. Beeley, Utah University, Salt Lake City, "The problem of handedness."

Professor Tracy H. Abell, Utah Agricultural College, Logan, "Investigations in dehydration."

Dr. M. C. Merrill, Utah Agricultural College, Logan, "Distilled water as a medium for growing plants."

Dr. Frank L. West, Utah Agricultural College, Logan, "Determination of probable temperature at a particular place for a definite hour on a definite day."

Dr. F. S. Harris and N. I. Butt, Utah Agricultural College, Logan, "Alkali water for irrigation."

Professor D. W. Pittman, Utah Agricultural College, Logan, "The relation of the method of analyzing alkali soils to the limit of toxicity."

Dr. Willard Gardner, Utah Agricultural College, Logan, "A theory of capillary flow."

Dr. Joseph F. Merrill, Utah University, Salt Lake City, "Is electric air heating feasible?"

Dr. W. D. Bonner, Utah University, Salt Lake City, "Atoms and the atomic theory."

C. F. Korstian, Forest Service, Ogden, "Evaporation and soil moisture in relation to forest planting."

C. Arthur Smith,
Corresponding Secretary

THE KANSAS ACADEMY OF SCIENCE

The fifty-first annual meeting of the Kansas Academy of Science was held at the State Agricultural College, Manhattan, April 18 and 19. There was in attendance an excellent representation of the scientists of the educational institutions, scientific professions and industries of the state.

"The cultivation of medicinal plants in the United States," illustrated, was the subject of the presidential address, by Professor L. D. Havenhill, of Kansas University.

Professor Henry B. Ward, of the University of Illinois, the visiting scientist, delivered two lectures, one on "The conservation of our aquatic resources," and the other on "Research and reconstruction," the latter to the faculty, students and friends of the college as well.

President W. M. Jardine addressed the academy on the problems and aims of the Kansas Agricultural Experiment Station, and described some of the projects under way.

Sixty-one papers were presented, either by title or read, most of them reports of progress and accomplishment in research.

A banquet was served during the evening of the eighteenth which was attended by more than one hundred persons. Dean L. E. Sayre, of Kansas University, was toastmaster, and talks were made by President Jardine, Professor Ward, Major E. L. Holton, of the Red Cross, and Representative Hughbanks, of the Kansas legislature.

The academy formally voted to accept the invitation to affiliate itself with the American Association for the Advancement of Science according to the plan previously published in Science.

Dr. Robert K. Nabours, of the Agricultural College, and Dr. B. M. Allen, of Kansas University, were elected president and first vice-president, respectively, for the coming year.

E. A. White,
Secretary

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FIFTY YEARS OF THE AMERICAN MUSEUM OF NATURAL HISTORY

It has become necessary to postpone the celebration of the fiftieth anniversary of the charter of the museum for five years, namely, until 1924. It is hoped that this celebration may be marked by the completion of the entire southern half of the museum, as planned between 1870 and 1875, as the year 1924 will mark the period of half a century since the building was actually begun by the City of New York.

In the meantime at the request of the editor of Science, there is here presented a review of certain aspects of the development of the institution during its first fifty years, based on the *Annual Report* of the president to the trustees.

The American Museum has broken away from many old museum traditions and customs and has been constantly striking out along new lines in every branch of its activity. In exploration, while making North America our chief concern, we have reached out into South America, Africa, Asia, and, in certain branches, into Europe itself. The natural history of our new colonial wards, the Philippines and Porto Rico, are matters of intimate concern. In South America, through a series of expeditions we are exploring every part of the continent and have established most cordial personal as well as scientific relations.

This is in keeping with the world-wide extension of American interests and influence and is part of the inevitable participation of America in the world's affairs. Neither the American Museum, nor our government, nor our people can remain isolated or bound by the confines of our own continent. Thus, while more than ever an *American* Museum, our institution has become a *world* museum. In increasing degree it is bringing all parts of the world within the view of the millions

of people who can never travel and never explore and whose only means of finding the inspiration of travel is through looking into the mirror which we are endeavoring to hold up to nature in all of its wonderful aspects.

A summary of the general progress in the last fifty years shows that the great museum building projected in 1870 is about one fourth completed; that during this period the trustees, members and friends of the museum have contributed gifts and collections valued at $7,250,000, while the contributions to the permanent endowment fund have been $7,322,707. In the meantime, the taxpayers of the City of New York have contributed $5,318,820 for building and $4,241,492 for maintenance. The unrestricted endowment fund, which may be devoted to the general progress of the museum, is now approximately $1,300,000, while during the last year and a half additional bequests to the institution for general purposes amount to $2,105,000, including Mrs. Russell Sage's bequest of $1,600,000. It is fortunate that the full amount of these bequests will be realized through the recent action of Congress in repealing the iniquitous federal tax on educational bequests imposed by the laws of 1916 and 1917.

The financial, material and scientific accomplishments of fifty years may be summed up as follows:

Total expenditure for building by the city of New York	$5,318,820
Total expenditure for maintenance by the city of New York	4,241,492
Total gifts to endowment by trustees, members and friends of the museum	7,322,707
Total contributions and gifts to the collections, publications and scientific work of the museum	7,250,000
Total number of exhibition halls at the present time	35
Total exhibition area (in square feet)	271,886
Total number of professional or scientific staff, 1918	54
Total number of employees, 1918	340
Total number of volumes of publications issued by the museum (*Bulletins, Memoirs, Monographs, Special Publications*)	90
Total number of American Museum members, 1918	4,568
Average number of visitors annually for the last ten years	806,005
Average number of school children reached annually for the last ten years.	1,121,799

The scientific work of the museum has been well provided for through the munificent bequests of Mr. and Mrs. Morris K. Jesup. By the terms of Mr. Jesup's will his bequest was strictly for the benefit of scientific exploration, research, preparation, exhibition and publication. The educational work of the museum, the contact with the public and the relations with the public schools are all inspired by this purely scientific work, yet they can not legitimately draw support from the Jesup Endowment. It is therefore to general endowment that we look for the means to extend this service to the people.

It is very gratifying to report that during the past three years several important gifts or bequests to the general endowment have been received, as follows:

Margaret Olivia Sage, special endowment for Ornithology	$10,000
Emil C. Bondy	10,000
Anson W. Hard, for the development of the Library	5,000
Charles E. Rhinelander (estimated)	20,000
Amos F. Eno	250,000
Helen C. Juilliard	50,000
David Lydig (contingent)	10,000
Emil Wolff (stock value)	5,000
Ludwig Dreyfus	10,000
Louisa Combe (estimated)	50,000
James Douglas	100,000
Margaret L. Baugh, for Anthropology	10,000
Mrs. Russell Sage (estimated)	1,600,000
	$2,130,000

Even if the museum should realize full value on all these bequests, the added income would be little more than sufficient to meet the present general running expenses, for the personal cash contributions of the trustees annually almost equal the income on $1,000,000, while the deficiency of the city maintenance appropriation is more than the interest on a one-million-dollar endowment. Conse-

quently, while these noble bequests swell the general endowment to more than $3,000,000, an additional $2,000,000 is required to put the museum on a secure financial footing for its general purposes.

The munificent bequest of Mrs. Russell Sage is by far the largest which the museum has received for its general purposes. It was accompanied by the following provision in Mrs. Sage's will:

It is my desire that each religious, educational or charitable corporation which may receive a share of my residuary estate shall use the whole or part of the legacy received by it for some purpose which will commemorate the name of my husband, but I simply express this as a desire and do not impose it as a condition of my gift.

The institution should be maintained in the future in the spirit of the contract of 1878 between the museum and the city, namely, that the city pay for the operating expenses, while the trustees pay for the collections and all the scientific work. In recent years the trustees have drawn so largely upon their own funds for maintenance purposes that the growth of the scientific collections and exhibitions has been held back, with the result that the people of the City of New York are the ultimate sufferers. Through a like policy, the New York Public Library and the Metropolitan Museum of Art are making similar inroads on the income from their endowment funds to meet current expenses, instead of purchasing books, pictures and works of art; in the end this means the deprivation of the people.

The expenditures for the maintenance of the museum by the people have increased far less rapidly than the expenditures of the city departments under political management: while the *per capita* cost of the city government has *increased* more than 30 per cent. in the last twenty years, the *per capita* cost of maintenance of the museum has *decreased* 8 per cent. Inasmuch as the work of the museum for the education of the people is in no sense a luxury, it is reasonable to expect that maintenance costs shall increase proportionately with the costs of the city government. In general we may regard the reduction of the maintenance appropriation for the museum as in reality a reduction of expenditures for education, and any city with the wealth of New York ought to provide liberally for education. At the present time the taxpayers of the City of New York are paying less than one third of the annual cost of the American Museum and its work. If the taxpayers really understood the situation, they would support the city government in granting larger maintenance appropriations.

Although the field exploration of the museum was in general suspended until after the war, it was found expedient to continue on a small scale certain explorations in China as well as in various parts of North and South America.

The year 1918, however, has been one of the most active in the entire history of the museum in research and in publication, which is mainly supported through the generous provision of the Morris K. Jesup Fund. This fund now amounts to $6,672,000.

In zoology, Mr. Roy C. Andrews sailed for China on June 28 to take up the work of the Second Asiatic Zoological Expedition. Mr. Andrews will make studies and collections in the Gobi Desert, a region little known to the naturalist. The Third Asiatic Zoological Expedition left San Francisco on July 27, under the leadership of Mr. Paul J. Rainey, accompanied by Mr. Edmund Heller as naturalist; the entire expense of the expedition was borne by Mr. Rainey.

In anthropology, Mr. Earl H. Morris, assisted by Mr. B. T. B. Hyde, continued the excavation of the Indian ruins at Aztec, New Mexico. These ruins are yielding valuable collections and historic data, which make this piece of research work one of the most important that the museum has ever undertaken in anthropology. These explorations are made possible through the contributions of Mr. Archer M. Huntington. Mr. Leslie Spier made archeological explorations in Arizona, visiting the Fort Apache Indian Reservation in the White Mountains, and the Rio Verde Valley. He also visited the Havasupai

Indians for the purpose of making ethnological studies and collections. Dr. Herbert J. Spinden returned in December from an expedition of eighteen months in Central America and the United States of Colombia. His work was entirely successful, especially along the lines of decorative art, in which connection he secured important archeological and ethnological collections.

In marine zoology, during the summer, Mr. Roy W. Miner and other members of the Department of Invertebrate Zoology spent several weeks at Woods Hole, Mass., making field studies for the Bryozoan Group for the Darwin Hall.

In paleontology, Mr. Walter Granger completed the exploration of the Huerfano Basin, Colorado, and secured a very interesting fauna, which links up the Lower Eocene and the Middle Eocene. Three months were spent by Mr. Albert Thomson in exploration of the Snake Creek deposits in western Nebraska, where he obtained a considerable number of fossil mammals, including skulls of a very large rhinoceros and a rare and interesting rodent.

It is an auspicious coincidence that the first volume of the publications of the American Museum Congo Expedition appears at the time of the release of Belgium from the oppression of war, and that the museum is in a position to send to the Belgian government a report on the achievements of the Congo Expedition, which, it will be recalled, was instituted with the financial and political support of the Belgian government in 1908. It is proposed to publish these reports under the general title, *Zoology of the Belgian Congo,* and to issue a series of eight to ten volumes composed of articles contributed to current numbers of the American Museum Bulletin by members of the museum staff and by other foremost naturalists and specialists of this country. When the various groups of animals are fully reported on, the reports will be gathered into volumes according to their taxonomic groups, that is, the papers on mammals will be published together, the papers on birds, and so forth.

The statistics of the numbers reached by the museum through its extensional system show a total of 1,528,523, a falling off of approximately 500,000 since 1914 owing to war conditions. The museum has become a center for all the natural history work carried on by various organizations in the New York area; it supplies materials for all grades of education, from the pupils of the kindergarten to the most advanced investigators in the research departments of Columbia and other universities. Among the societies and organizations that visited or held meetings at the museum in 1918 were:

American Association for the Advancement of Science, Section E.
American Ethnological Society.
American Nature Study Society.
American Ornithologists' Union.
American Scenic and Historic Preservation Society.
Angle School of Orthodontia, Eastern Association of Graduates.
Aquarium Society.
British Educational Mission to the United States.
Catherine Abbé Club.
Chautauqua Bird and Tree Club.
City History Club.
Columbia University, Classes in Anthropology, Zoology and Paleontology.
Department of Education, New York City, free public lecture courses.
Elsie Rutgers Club.
DeWitt Clinton High School.
Galton Society for the Study of the Origin and Evolution of Man.
Horticultural Society of New York.
Inkowa Club.
Joan of Arc Club.
Keramic Society of Greater New York.
Linnæan Society of New York.
Massachusetts Normal Art Alumni Association, New York Chapter.
Mission of French Scholars.
New York Academy of Sciences.
New York Bird and Tree Club.
New York Entomological Society.
New York Microscopical Society.
New York Mineralogical Club.
School Nature League.
Torrey Botanical Club.

The development of the museum during the next five years in preparation for its golden jubilee will, it is hoped, include three great features, namely, extension of building, firm foundation of popular municipal maintenance, and increase of the general or unrestricted endowment fund to $5,000,000, the amount needed to place the museum on a financially sure foundation for the coming quarter of a century.

Henry Fairfield Osborn

HERBERT HUNTINGTON SMITH

The wide circle of his friends and acquaintances were shocked to read in the daily journals that on March 22 Mr. Herbert Huntington Smith, the curator of the Alabama Museum, had been killed by being run over by a freight train. In recent years he had become very deaf, and it was owing to this infirmity that he came to his untimely end. Once before, in the city of Pittsburgh, he had been struck by an electric car, the approach of which he had not observed, but fortunately escaped at that time, with only a few bruises.

A number of years ago Lord Walsingham in an address before the Entomological Society of London in speaking of the work of field naturalists and the additions made by them to the sum of human knowledge, made the statement that the two ablest collectors were Americans, one of them the late William H. Doherty, the other Herbert Huntington Smith. With both of these men the writer of these lines was intimately associated, both of them having made extensive collections for him in foreign parts, and both came to their end under tragic circumstances. Doherty died in Uganda, as the result of nervous prostration brought about partly by exposure, partly by the fact that his camp was haunted by man-eating lions, which had killed several of his assistants. Smith passed away in the midst of important activities, as the result of a horrible accident.

My acquaintance with Mr. Herbert Huntington Smith, which has covered nearly thirty years of his life, enables me to speak of him with an appreciation founded upon intimate knowledge.

He was born at Manlius, New York, on January 21, 1851. He studied at Cornell University from 1868 to 1872. In 1870 he accompanied his friend and teacher, the late Professor C. F. Hartt, on an excursion to the Amazons. He thus caught his first glimpse of tropical life, which wove about him a spell which always thereafter bound him.

In 1874 he returned to Brazil for the purpose of collecting and studying the fauna of the Amazonian regions. Two years were spent in the neighborhood of Santarem, and subsequently he passed a year in explorations upon the northern tributaries of the Amazons and the Tapajós, after which he stayed about four months in Rio de Janeiro. Returning to the United States he was commissioned by the Messrs. Scribner to write a series of articles upon Brazil for their magazine, and accordingly made two more trips to that country, studying the industries, social and political conditions, and investigating the famine district in Ceará. On one of these journeys he was accompanied by Mr. J. Wells Champney, who was employed to prepare illustrations for his articles. One of the results of these journeys was the volume entitled "Brazil, the Amazons and the Coast," which was issued by Charles Scribner's Sons in 1879. On October 5, 1880, Mr. Smith married Miss Amelia Woolworth Smith, of Brooklyn, New York. She entered with zest into his labors, and in all the years which followed was his devoted and most capable assistant. There was a remarkable accord in their tastes and Mrs. Smith developed unusual skill and efficiency in the manipulative processes involved in collecting specimens of natural history. Indeed, it is no exaggeration to say that her learned husband would not have been able to accomplish the vast amount of work, which was achieved in later years, had it not been for her facile fingers. She became an accomplished taxidermist, and was able to prepare the skins of birds and preserve insects, in the most approved manner. Mr. Smith and his wife spent the years from 1881 to 1886 in Brazil. He made his general headquarters in Rio de Janeiro, where he received much encourage-

ment from the Emperor, Dom Pedro II., who was deeply interested in scientific research. During these years he traveled extensively and spent a long time in exploring the then little known territory along the upper waters of the Rio Paraguay and the Rio Guaporé on the western confines of Brazil, in the vicinity of Matto Grosso and Chapada. The extensive series of specimens which he gathered during these years of fruitful collecting were acquired partly by the National Museum in Rio de Janeiro, partly by Mr. D. F. Godman of London, and partly by the writer of these lines, who subsequently purchased most of the lepidoptera, and, at a later date by the Carnegie Museum, which secured most of the vast collection of insects which Mr. Smith had made, numbering approximately thirty thousand species and not far from two hundred thousand specimens.

In 1886 there appeared in Portuguese from his pen an account of some of his travels, entitled "De Rio de Janeiro á Cuyabá." Mr. F. D. Godman, whose monumental work, the "Biologia Centrali-Americana," called for an intensive study of the fauna of Mexico, commissioned Mr. Smith to make collections for him in that country, and he labored there during the year 1889. He spent much of his time in the years 1890–1895 in the employment of the West Indian Commission of the Royal Society in making collections in Trinidad and the Windward Islands, and in reporting upon the same. These collections are in the British Museum. During the same years he was actively engaged as one of the staff of writers employed in the preparation of the "Century Dictionary," the "Century Cyclopedia of Names," and "Johnson's Cyclopedia." In these works almost everything relating to South and Central America and the fauna and flora of these lands is from his pen.

When plans were being formed for the development of the Carnegie Museum, Mr. Smith took occasion, not only in letters but by personal visits to the writer, to urge the desirability of selecting as one of the major objects of the new institution, a biological survey of South America. While it was not at that time possible to fully accept his proposals, one of the results of his visits to Pittsburgh, was his employment by the infant museum to act in a curatorial capacity, devoting himself to the formation of collections illustrating the natural resources of the region of which Pittsburgh is the metropolis. Assisted by his wife and various volunteers he made extensive collections representing the flora and fauna of western Pennsylvania and West Virginia. These collections number many tens of thousands of insects, shells, and plants, as well as fishes, reptiles, birds, and small mammalia. When not in the field, he devoted his time to the arrangement of collections which began to rapidly come into the possession of the museum.

He was not, however, entirely happy in the confinement of the walls of a museum. He constantly heard "the call of the wild," and his heart longed for the life of the tropics, in which he had passed so many happy years. He proposed to the authorities of the Carnegie Museum that he should be allowed to go to the United States of Colombia to make collections. The writer agreed himself to become the purchaser of the collections of lepidoptera which might be made, the Carnegie Museum agreed to purchase the birds, a set of the mammals, the ethnological material which might be gathered, and to take one or more sets of the botanical specimens collected. Accompanied by his wife and young son he set out for Colombia to begin his work in the Province of Santa Marta. One of the chronic revolutions of that period developed and he encountered much difficulty. The period from the fall of 1898 to the spring of 1902 was spent in this work. It was a period of trial and hardship. Mr. Smith finally fell ill and it was feared that he would not recover. When at last he was pronounced to be out of danger the party hastened to return to the United States and thenceforth all thought of further investigations in the tropics was abandoned. The collections made in the face of hardship and disease were nevertheless large and valuable and contained many species wholly new to science.

Mr. Smith and his wife on their return, resumed their employment at the Carnegie Museum, devoting themselves to the arrangement of the Colombian material and to the classification of the large and increasing collections of mollusca belonging to the museum. One of the results of this period is the "Catalog of the Genus *Partula*" which was published in 1902. After about a year in Pittsburgh, Mr. and Mrs. Smith felt the need of a change and resolved upon removal to Wetumpka, Ala., where they began the systematic collection of fresh-water shells, belonging to the family of Strepomatidæ, which abound in the Coosa and other rivers of that region. They were supported in their work by four ardent conchologists: Mr. George H. Clapp, of Pittsburgh, Messrs. John B. Henderson and T. H. Aldrich, of Washington, D. C., and Mr. Bryant Walker, of Detroit, Mich., who formed a "syndicate" to enable the work to be done. When Mr. Aldrich dropped out of their number, Professor H. A. Pilsbry, of the Academy of Natural Sciences in Philadelphia, took the vacant place for such time as he was able to command the necessary funds. In 1910 Dr. Eugene A. Smith, of the Geological Survey of Alabama, induced Mr. and Mrs. H. H. Smith to take charge of the museum at the University of Alabama, and here they have been engaged for nearly a decade in arranging and caring for the collections which have been accumulated principally by the Geological Survey of Alabama. For the past two or three years the Alabama Museum and the Carnegie Museum have been working conjointly in the exploration of the Tertiary deposits of Alabama, under the oversight of Mr. Smith, and the result has been discovery of a number of new and rich deposits of Tertiary mollusca. Vast series of specimens had been gathered by our indefatigable friends, and the last letter received by the writer contained a request for a fresh supply of labels. It was written only a day or two before the lamented death of the sender.

Mr. Smith was not a mere collector of natural history specimens. He was a naturalist in the true sense of that much abused word. He had a wide and accurate knowledge of the major divisions of the animal kingdom and keen powers of discrimination. He was especially well versed in conchology, though he wrote and published but little. He was a systematist of far more than ordinary ability, whose opinions were received with great respect by those who employed him. He was an accomplished linguist. He was familiar with the Greek and Latin classics, spoke Spanish readily and used Portuguese as if it were his mother tongue. He also had a good knowledge of French and German, sufficient to enable him to consult works in those languages. He was one of the survivors of a group of naturalist explorers and investigators to whom we are indebted for much of our knowledge of the fauna and flora of tropical America. He belonged to an illustrious company which, beginning with Humboldt and Bonpland, included in its ranks such men as Alfred Russel Wallace, Henry W. Bates, J. N. Natterer, J. J. Tschudi, J. B. Hatcher and J. D. Haseman, who courageously faced dangers in the wilderness in order to secure information at first hand as to the fauna and flora of the great continent where they labored.

W. J. HOLLAND

CARNEGIE MUSEUM

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PASADENA MEETING OF THE PACIFIC DIVISION

THE third annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held at Pasadena, Calif., during the period June 19–22, 1919. On account of the war no meeting was held in 1918.

The address of the retiring president, Dr. D. T. MacDougal, on "Growth of Organisms" will be delivered on Thursday evening in the Palm Room of the Hotel Maryland, following which a public reception will be held. The address of welcome will be given by President James A. B. Scherer, of Throop College of Technology, and the response by

Dr. Barton Warren Evermann, the chairman of the executive committee.

Special considerations related to the exigencies of the times have induced the executive committee to arrange a program which it is hoped will bring together, in two half-day sessions, the entire attendance of the meeting irrespective of society affiliations and special interests. This is something of an innovation but it is believed the importance of the subjects to be presented and the community of interest involved will justify this departure.

Thursday afternoon, June 19, will be devoted to a symposium in which the projected Exploration of the North Pacific Ocean will receive a thorough exposition as regards its economic and scientific possibilities. The importance of this project to the people of the Pacific area can scarcely be overestimated. The Pacific Ocean as a source of food supply remains largely undeveloped. That a scientific survey of this little-known portion of the globe will result in very tangible benefits is not to be doubted. There are, moreover, many scientific questions pertaining to meteorology, geodesy, geology, etc., which will be clarified by the proposed investigations.

The aims of the symposium are to impress upon the people generally of western North America their vital interest in the general subject under consideration; and to advance the problem of ways and means of carrying out the contemplated explorations and investigations. Care has been observed in assigning the topics to men qualified by experience to treat them briefly and cogently.

The arrangement of the symposium is as follows:

Problems of Population of the North Pacific Area as Dependent Upon the Biology, the Oceanography and the Meteorology of the Ocean: Dr. W. E. Ritter, director, Scripps Institution, University of California, La Jolla.

The Northern Fur-seal Problem as a Type of Many Problems of Marine Zoology: Dr. Barton W. Evermann, director, California Academy of Sciences, San Francisco.

Scientific and Economic Problems of the Mammals and Birds generally of the North Pacific: Dr. Joseph Grinnell, director, Museum of Vertebrate zoology, University of California, Berkeley.

Peculiarities in the Scientific Problems of the Fisheries of the North Pacific: Professor John N. Cobb, director, College of Fisheries, University of Washington, Seattle, Washington.

The Problem of the Organic Fertility of the North Pacific Ocean: Mr. E. L. Michael, zoologist, Scripps Institution, University of California, La Jolla.

Currents, Temperatures and Salinities of the North Pacific: Mr. G. F. McEwen, hydrographer, Scripps Institution, University of California, La Jolla.

Barometric Pressures, Winds, Storms, Etc., of the North Pacific: Mr. E. A. Beals, district forecaster, United States Weather Bureau, San Francisco.

Fundamental Problems in the Geology of the North Pacific Region: Dr. George D. Louderback, associate professor of geology, University of California, Berkeley.

On Friday afternoon, June 20, another symposium will be presented which will be of interest to workers in every department of science. Its stated purpose is "to stimulate the spirit of scientific inquiry and research and to disseminate scientific information among the people." The need for more research men, with better equipment for their work, is keenly felt. The generous support of the people and the government is required not alone in solving the immediate problems of the day but in furthering and promoting research in all branches of science. The assignment of speakers in this symposium on "Scientific education in a democracy" is as follows:

The Dependence of a Community on Scientific Experts: Dr. James A. B. Scherer, president, Throop College of Technology, Pasadena.

The Responsibilities of the Scientist: Dr. George E. Hale, director, Mount Wilson Observatory, Carnegie Institution of Washington, Pasadena.

The Press as an Intermediary between the Investigator and the Public: Honorable Chester H. Rowell, editor of the *Fresno Republican*, Fresno.

The Graduate School; Its New Duties: Dr. W. F.

DURAND, professor of mechanical engineering, Stanford University.

The Early Training of the Scientific Expert: DR. E. W. BAILEY, supervisor of science, University School, Oakland.

The Relation of the Engineer to Scientific Investigation and to the General Public: DR. J. A. L. WADDELL, consulting engineer, Kansas City, Missouri.

Must Learning Be Mediocre in a Democracy? DR. E. C. MOORE, president, State Normal School, Los Angeles.

Friday evening, June 20, a public address will be given in the Palm Room of the Hotel Maryland by Dr. S. D. Townley, professor of applied mathematics, Stanford University, the subject being "Earthquakes on the Pacific Coast of North America."

MEETINGS OF AFFILIATED SOCIETIES

Following are announcements of the various societies which will meet under the auspices of the Pacific Division:

ASTRONOMICAL SOCIETY OF THE PACIFIC

Beverly L. Hodghead, president, 1715 Euclid Ave., Berkeley.

R. T. Aitken, first vice-president, Lick Observatory, Mount Hamilton.

Dorothea Klumpke Roberts, second vice-president, 1106a Valencia St., San Francisco.

D. S. Richardson, secretary-treasurer, University of California, Berkeley.

The Astronomical Society of the Pacific plans to hold two sessions for the discussion of scientific papers. The first, from 10 A.M. to 12 M., June 19, at Throop College; the second from 9.30 A.M. to 12 M., Friday, June 20, also at Throop College. Papers of particular interest to physicists will be discussed at the meeting on Friday morning, and members of the American Physical Society are especially invited to be present. The American Astronomical Society has been invited to meet with the Astronomical Society of the Pacific. If the invitation be accepted, probably the only change in the above program would be an extra session on Friday afternoon for scientific discussions. It is expected that a number of papers from the Pacific Coast observatories will be presented. Astronomers from the Lowell Observatory, the Dominion Astrophysical Observatory, Pomona College, and Mount Wilson have signified their intention of attending these meetings.

AMERICAN PHYSICAL SOCIETY

J. S. Ames, president, Johns Hopkins University, Baltimore.

D. C. Miller, secretary, Case Scientific School, Cleveland, Ohio.

E. P. Lewis, local secretary, University of California, Berkeley.

The American Physical Society will hold a meeting Thursday morning, June 19, at Throop College. On Saturday the offices and laboratories of the Mount Wilson Observatory in Pasadena will be open to visitors, and there will be an excursion, open to all members of the society, to the observatory on Mount Wilson.

CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

L. H. Duschak, president, University of California.

Robert E. Swain, acting president, 638 Channing Ave., Palo Alto.

Bryant S. Drake, secretary-treasurer, 5830 Colby St., Oakland.

J. Pearce Mitchell, John S. Blowski, William C. Bray, councilors.

The meeting of the California Section of the American Chemical Society will be held Saturday evening, June 21, in conjunction with the Southern California section of the American Chemical Society.

COOPER ORNITHOLOGICAL CLUB

Northern Division

Barton W. Evermann, president, California Academy of Sciences, San Francisco, Calif.

Jules Labarthe, vice-president, 2715 Steiner St., San Fancisco, Calif.

Mrs. James T. Allen, secretary, 37 Mosswood Road, Berkeley, Calif.

Southern Division

Loye Holmes Miller, president, State Normal School Los Angeles, Calif .

Howard Robertson, vice-president, Hosfield Building, Los Angeles, Calif.

L. E. Wyman, secretary, 3927 Wisconsin St., Los Angeles, Calif.

The Cooper Ornithological Club will hold joint sessions with the Western Society of Naturalists.

CORDILLERAN SECTION, GEOLOGICAL SOCIETY OF AMERICA

Henry Landes, president, University of Washington, Seattle, Wash.

Charles E. Weaver, secretary, University of Washington, Seattle, Wash.

A meeting will be held of the Cordilleran Section of the Geological Society of America, the details of which will be announced later.

ECOLOGICAL SOCIETY OF AMERICA

Barrington Moore, president, American Museum of Natural History, New York, N. Y.

Thomas L. Hankinson, vice-president, Eastern Illinois State Normal School, Charleston, Ill.

Forrest Shreve, secretary-treasurer, Desert Laboratory of the Carnegie Institution, Tucson, Arizona.

A meeting of the Ecological Society of America will be held at Throop College.

A joint session with the Western Society of Naturalists, for the reading of invited papers, has already been planned. Two trips have been arranged for June 21, one to Mount Wilson and the Observatory of the Carnegie Institution, and one to the rich fossil deposits at Rancho La Brea.

PACIFIC COAST BRANCH, PALEONTOLOGICAL SOCIETY

Bruce L. Clark, president, University of California, Berkeley, Calif.

Chester Stock, vice-president, University of California, Berkeley, Calif.

Chester Stock, secretary-treasurer, University of California, Berkeley, Calif.

The Pacific Coast Branch of the Paleontological Society will hold its meeting in conjunction with that of the Cordilleran Section of the Geological Society of America. The program to be presented will be announced at a later date.

PACIFIC SLOPE BRANCH, AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

H. J. Quayle, chairman, Riverside, Calif.

E. O. Essig, secretary, Ventura, Calif.

The annual meeting of the Pacific Slope Branch of the American Association of Economic Entomologists will be held this year at the Citrus Experiment Station, Riverside, California, May 28–29, in connection with the California Fruit Growers' Convention. It is expected that many members will arrange to attend the meeting of the Pacific Division also.

SEISMOLOGICAL SOCIETY OF AMERICA

C. F. Marvin, president, U. S. Weather Bureau, Washington, D. C.

C. F. Tolman, Jr., first vice-president, Stanford University, Calif.

Otto Klotz, second vice-president, Dominion Astronomical Observatory, Ottawa, Canada.

H. O. Wood, third vice-president, Cosmos Club, Washington, D. C.

S. D. Townley, secretary-treasurer, Stanford University, Calif.

The sessions of the Seismological Society will be correlated with those of the Cordilleran Section of the Geological Society of America and of the Pacific Coast Branch of the Paleontological Society, but the exact time of the meetings has not yet been determined. Several papers have been promised for the meeting of the Seismological Society and it is expected that an interesting program will be presented.

SIERRA CLUB

Wm. E. Colby, president, 402 Mills Building, San Francisco, Calif.

Vernon L. Kellogg, vice-president, Stanford University, Calif.

J. N. LeConte, secretary, Berkeley, Calif.

Marion Randall Parsons, treasurer, Berkeley, Calif.

The Southern California Section of the Sierra Club will arrange an outing in the vicinity of Pasadena that will permit of attendance upon the meetings of the Pacific Division by the members. A future announcement will give details of the outing.

SOUTHERN CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

W. L. Hardin, president.

H. J. Lucas, vice-president.

J. S. Carman, treasurer.

H. L. Payne, secretary, 223 West First St., Los Angeles.

E. O. Slater, E. E. Chandler, councilors.

A meeting of the affiliated sections of the American Chemical Society will be held Saturday evening, June 21.

WESTERN SOCIETY OF NATURALISTS

T. C. Frye, president, University of Washington, Seattle, Washington.

Forrest Shreve, vice-president, Desert Laboratory, Tucson, Arizona.

Tracy I. Storer, (acting) secretary-treasurer, Museum of Vertebrate Zoology, Berkeley, Calif.

The Western Society of Naturalists will hold sessions for the presentation of papers on biological subjects on Thursday and Friday, June 19 and 20, at 9 A.M. One of these will be a joint session with the Ecological Society of America. On the afternoons of these two days the society will meet with other organizations in the two symposia under the Pacific Division. On the evening of Friday, June 20, a dinner for members of the society will be held at one of the local hotels. Luncheon will be provided at Throop College of Technology on Thursday and Friday for all in attendance at the scientific meetings. On Saturday, June 21, there will be a field excursion up Mount Wilson Via Sierra Madre and Little Santa Anita Canyon. This trip affords excellent opportunity to see the fauna and flora of the region from the dry washes at the southern base of the San Gabriel Mountains to the Transition Zone forest on the top. At the observatory opportunity will be afforded to see the astronomical equipment. Luncheon will be provided for all visitors. Those who do not care to walk may arrange for transportation up and down the mountain. Other trips to Rancho La Brea and Catalina Island.

PACIFIC FISHERIES SOCIETY

Barton Warren Evermann, president, California Academy of Sciences, San Francisco.

C. McLean Fraser, vice-president, Nanimo, British Columbia.

G. E. Hoffses, vice-president, Seattle, Wash.

Willis H. Rich, secretary, Stanford University, Calif.

E. Victor Smith, treasurer, Seattle, Wash.

The Pacific Fisheries will hold sessions on Thursday and Friday.

A UNION OF SCIENTIFIC FEDERAL EMPLOYEES

THE recent formation of a union of scientific employees of the federal government is an event of more than local importance, as is also the work of the Congressional Joint Commission on Reclassification of Salaries of federal employees. The work of this commission was the immediate cause of the formation of the union, which took place at a mass meeting at the New National Museum in Washington, May 8, 1919.

In the call for the mass meeting the advantages of organization which had been urged were summarized as follows: improvement of conditions and facilities for more effective scientific and technical work; adequate presentation of the needs and results of such work to the public and to legislative and administrative officers (the Reclassification Commission wishes to deal with employees through organizations, and not as individuals); greater freedom in both official and non-official activities; just and reasonable salaries based on service performed and the economic and social conditions which prevail; greater public recognition of the aims and purposes of research; advancement of science and technology as an essential element of national life.

While the advantages of forming a national scientific union had been the subject of considerable discussion it was felt by the committee that such an organization could not possibly be formed in time for the work of the Reclassification Commission, and only the following plans were suggested for consideration at the mass meeting:

Plan No. 1.—To work only through existing scientific organizations.

Plan No. 2.—To form an independent organiization of those federal employees doing scientific or technical work.

Plan No. 3.—To form a scientific and technical branch of Federal Employees Union No. 2. (Union No. 2 is the main Washington section of the National Federation of Federal Employees, and has 21,000 members.)

Plan No. 1 received very little support, but there was a spirited discussion between the advocates of plans 2 and 3, the point at issue being the advisability of organizing as a branch of the Federal Employees Union, which is affiliated with the American Federation of Labor. Plan 3 was adopted by a substantial majority, although there was a considerable minority composed of those favoring either Plan 1, or Plan 2, together with a small number favoring a separate organization directly affiliated with the American Federation of Labor.

In order that work might be started without waiting to perfect a permanent organization, a temporary organization was formed composed of a general interim committee, consisting of a chairman, a secretary, and representatives from the bureaus, one for each twenty members. The organization is already functioning, while the permanent organization is being worked out.

The considerations which lead to the organization of scientific and technical employees of the government into a branch of the Federal Employees Union may be summarized as follows:

1. The belief that science can never play its real rôle in the development of our national life until the great body of workers of the nation has a sympathetic understanding of the significance of research, and that such an understanding can be brought about only by the scientific workers joining hands with the other workers of the nation.

2. Specifically, the belief that the affiliation will greatly accelerate a general understanding of the economic relation between scientific research and the problem of a higher national standard of living; and that, when the workers generally, fully realize that there is a limit beyond which the standard of living of the average of the population can not progress by usual methods of readjustment, and that this limit can only be raised by research and the utilization of the results of research in industry, the cause of science will be placed in a position which we can not now anticipate.

3. The necessity of contact with a body having the confidence of, and influence with, those with whom decisions rest.

4. The complete autonomy enjoyed by the Federal Employees Union in its affiliation with the American Federation of Labor, and by the Scientific and Technical Branch in its affiliation with the former.

5. The complete freedom from any compulsion upon the individual, the constitution pledging all its members not to strike, or support any strike against the government.

6. The methods and the record of the Federal Employees Union. There has been cordial cooperation with legislative and administrative officials in collating and presenting reliable data, which has produced very concrete results without producing friction or resentment. For half a century the status of the government employees had, on the whole, not improved, or had even grown worse. In three years of organization four important advances have been made: the enactment of a compensation law; the presidential veto of a bill increasing hours of service without an increase in pay; a flat increase of $120 (next year $240) for all employees receiving $2,500 or less per year; and the formation of the Reclassification Commission.

7. The urgency of the reclassification problem, which made it doubtful whether a new independent organization could be formed in time to be effective, while here was at hand a going, experienced organization with machinery and funds available, and already working in close cooperation with, and enjoying the complete confidence of, the commission; and this organization already numbered among its members more than six hundred of the scientific workers, among them many of the ablest and best known men in the scientific service.

The Reclassification Commission is to recommend a plan of classification and compensa-

tion to Congress by January, 1920. The members of the Commission are Senators Jones (chairman), Henderson and Spencer, and former Representatives Keating (secretary), Cooper and Hamlin. The commission is doing the work through central committees on which the commission, the administrative officers and the employees (through their organizations) are represented. Thus it is expected that misunderstandings will be avoided or removed as they arise, and that the completed work may receive the support of all the interests concerned.

The work of this commission seems bound to have a profound influence on the scientific services of the government for a decade or more, no less from the point of view of the government than from that of the individual. Its influence will not stop with the government service, but will extend indirectly to practically all scientific laboratories, college. university, industrial, state, and municipal. By cooperating, by furnishing data from similar studies that may have been made in other organizations, men in such laboratories can do their colleagues in the federal departments a very real service, and a service to the cause of science and to the fraternity as well. General arguments will not be useful. What is needed is comparative data, such for example as salary studies made by universities, or statistical studies of the investment equivalent of a university training, the accuracy of which can be vouched for. The commission is undertaking the problem in the same spirit that is necessary in an investigation in chemistry or in biology.

R. H. TRUE, *Chairman*,
Bureau of Plant Industry,
P. G. AGNEW, *Secretary*,
Bureau of Standards

WASHINGTON,
May 12, 1919

SCIENTIFIC EVENTS

A BRITISH GEODETIC AND GEODYNAMIC INSTITUTE[1]

A COMMITTEE, consisting of Dr. Shipley (the Vice-Chancellor), Dr. H. K. Anderson, Col. Sir C. F. Close, Sir Horace Darwin, Sir F. W. Dyson, Dr. E. H. Griffiths, Sir T. H. Holdich, Sir Joseph Larmor, Col. H. G. Lyons, Professor Newall, Sir Charles Parsons, Sir Napier Shaw, Sir J. J. Thomson and Professor H. H. Turner, has been formed for the purpose of making an appeal for the creation and endowment of a geophysical institute at Cambridge. The question of the establishment of an institute of this character has been under consideration by the British Association for the last three years. A large and representative committee reported unanimously in favor of the project, which was then considered by the Conjoint Board of Scientific Societies. This Board also reported that there was a real need for such an institute. The chief reasons which have been put forward on behalf of the scheme are: (1) Geodetic work must form the basis and control of all the state surveys of the empire, on which about a million sterling was spent annually before the war. (2) A geophysical institute could render great assistance in connection with the particular group of geodetic problems now of most practical interest in the United Kingdom, namely those associated with leveling, mean sea-level, and vertical movements of the crust of the earth. (3) Such an institute is greatly needed to assist in the study of the tides and in attacking the great problems which must be solved if tidal prediction is to advance beyond its present elementary and fragmentary state. (4) There is at present no provision for the collection and critical discussion of the geodetic work which is being done within the Empire, or for its comparison with the work of other countries. There is no institution available for research work or higher training in geodesy. There is no British institution which can be referred to for the latest technical data and methods, and until the outbreak of the war it was the custom of many British surveys (notably the survey of India), when confronted with geodetic problems, to refer to the Geodetic Institute at Potsdam. This was not even then a very satisfactory arrangement, and now a radical change is inevitable.

[1] From *Nature*.

Discussion as to where the institute could most suitably be established has led to the selection of Cambridge, for it is essential that an institute of geodesy and geodynamics should be associated with a great school of mathematics and physics, and it is only in connection with a great Imperial university that that width and freshness of outlook are to be sought which are essential to a progressive and practical science. The committee has evidence that an institute at Cambridge would be cordially welcomed by the national survey departments, both terrestrial and oceanographic.

It is estimated that an endowment of £50,000 will be necessary if the proposed institute is satisfactorily to perform the double task of research and education, but it is hoped that if half that sum were contributed by private benefactions the remainder would be forthcoming from national funds. An essential part of the scheme would be the foundation of a university professorship of geodynamics to be held by the director of the institute. To place this professorship in line with other chairs recently endowed by private benefactions and usually associated with the names of the donors or founded as memorials of national sacrifice in the great war, a sum of £20,000 (which is included in the £50,000 mentioned above) would be required. It is certain that all who have to do with our shipping interests or with aerial navigation would ultimately profit from the establishment of such an institute.

THE CAWTHRON INSTITUTE

A New Zealand correspondent sends information to the effect that before the Parliamentary Committee of Industries at Nelson recently Mr. T. A. H. Field, M.P., one of the trustees of the Cawthron Institute, spoke concerning the proposals of the trustees. He said that during the war the trustees had been able to do very little, but in that period they had increased the income of the institute to £11,000 per annum, which would be spent in research work. The trustees had also initiated certain scholarships for scientific training which in seven years' time would be absorbing £1,100 per annum.

In the course of his replies to questions, Mr. Field said: The Board of Science and Industry, recommended by the New Zealand Institute and strongly backed by the National Efficiency Board, would have a statutory grant and therefore be free from ministerial interference. This proposed board might assist the Cawthron Institute with grants and subsidies in those cases in which large scale experiments of an expensive type had to be undertaken. The idea of the Board of Science and Industry was to subsidize liberally all research work in New Zealand, whether carried out in government laboratories, university colleges, research institutes, or by private individuals. The money would be paid by direct grants or in the form of fellowships or scholarships to be held at specified institutions for special purposes. As to the financial position of the Cawthron Institute, the cash invested amounted to £213,000, besides which there is land at Annesbrook valued at £5,075, and observatory lands valued at £500. The trustees aim at keeping the capital at £200,000, and paying for buildings, equipment, etc., from income. It is proposed to appoint at first a director, a chemist, and then a plant pathologist and an orchardist, and then increase in the direction that occasion demands.

When the work of the institute is well under way great help can be given to technical rural education in the Nelson district by means of lectures, demonstrations and scientific advice. Courses of lectures could be arranged not only in Nelson, but also in other centers. Practical demonstrations would naturally be made on the experimental grounds owned or controlled by the Cawthron Institute in different parts of the district. As fresh industries take root in the district, it will be a natural function of the institute to help in the establishment and to foster the growth of these industries by carrying out investigations that will assist in their vigorous development. A sum of £12,000 to £15,000 should cover the cost of buildings and equipment. It is proposed to have a large and carefully selected library, which is one of

the first needs of a research institute. Otherwise a worker may spend weeks, months, or even years, in arriving at the solution of a problem which has already been solved by some other worker, or which with proper library facilities could be solved in a few days. This library will be at the service of all research workers in New Zealand. It is also proposed to maintain the most friendly relationship with the Departments of Agriculture, Education and Mines, so that the work of the institute and of the government departments should be complementary to each other, having for their ultimate objects the welfare and advancement of the Dominion and of the empire. The late Mr. Cawthron was very much interested in the establishment of a solar observatory in Nelson, whose climate is particularly suited for this purpose.

ANTHROPOLOGICAL EXPLORATIONS OF ALASKA

THE *Pennsylvania Gazette* reports that Chief Louis Shotridge, of the Chilkat of the Tlikmit Indians of Southwestern Alaska, long a member of the staff of the University Museum, has returned from four years' explorations among his own people. In that time he secured many hundreds of unique ethnological specimens for the museum, having spent most of his time collecting and writing down in the native language the manners, customs, traditions and religious rites of the various tribes. It is believed that Mr. Shotridge is the first trained anthropologist who has ever done work of this sort among the American Indians using the native tongue. Chief Shotridge took all his notes in the Chikat language and will now spend the coming months in reducing them to English and making explanatory notes, which will form unique volumes in the history of our aborigines.

Mr. Shotridge took along a phonograph to record folk-songs and especially the ceremonial chants which accompany every great demonstration of the tribe. Unfortunately, the guttural sounds did not record well, so he was obliged to commit all these songs to memory. They will be taken down at once in ordinary musical notation by an expert. There are more than thirty of these ceremonial hymns. In addition he learned more than 100 folk-songs, which will be recorded. All of these will also be recorded on the phonograph.

Mr. Shotridge says that his people are so rapidly acquiring civilized customs and manners that before long there will be left none to hand down the ancient culture. He considers himself fortunate to have been able to find enough old people in his tribe to make the records complete.

The specimens he brought back are in many instances unique and some were given because the medicine men and chiefs foresee the extinction of native culture and want the relics preserved. The collections preceded Mr. Shotridge, and most of them are now on exhibition at the University Museum. Mr. Shotridge brought back a bride from his own tribe, who will assist her husband in his work.

A DEPARTMENT OF FOREST RECREATION OF THE NEW YORK STATE COLLEGE OF FORESTRY

A NEW department, that of Forest Recreation, has just been established at the New York State College of Forestry, Syracuse University. This department will assist in the development of the educational work of the college, both along investigational and instructional lines, in the proper uses of forest areas for public recreation purposes. The establishment of this department is in line with the endeavor of the college to make its work of real service to the people of the state and to increase the right use of forests and forest lands. This is the first department of forest recreation to be established in a school or college in this country.

With the great Adirondack and Catskill Forest Reserves, Palisades Inter-state Park, Letchworth Park and some thirty other public forest reservations, the whole totaling nearly two millions acres, New York state has unique forest resources capable of securing to its millions of people great public good in the way of recreational uses. Just as playgrounds are being established in villages and cities throughout the country where play may be organized and prop-

erly directed, so the forest of this and other states must be studied and developed that they may be more effective playgrounds for the people of the state.

This new department of forest recreation in the college of forestry will be in charge of Professor Henry R. Francis, who has made a specialty of this line of work and who during the past five years has been carrying on landscape extension work both in New York and Massachusetts. During the coming summer Professor Francis will begin systematic studies of forest and park areas in New York to prepare bulletins for recreational development, and late in the season will make a trip through the National Forests and National Parks of the west to see what has already been done by the national government and by the western states in developing the recreational possibilities of forest lands.

SCIENTIFIC NOTES AND NEWS

Professor Edward S. Morse has been reelected president of the Boston Society of Natural History.

The Edison Medal for meritorious achievement in electrical science or electrical engineering, has been awarded to Benjamin G. Lamme, of the Westinghouse Electric and Manufacturing Company, and was presented to him at the annual meeting of the American Institute of Electrical Engineers. The presentation was made by William B. Jackson, vice-president of the institute.

William D. Hurd, director of the extension service of the Massachusetts College and Station since its establishment in 1909, has resigned, his resignation to take effect about June. 1, to accept a position with the National Fertilizer Association with headquarters in the middle west.

Captain P. E. Landolt, of the Nitrate Division, Army Ordnance, has resigned from the service and has returned to his work as chemical engineer with the Research Corporation at New York City.

Professor Vaughan Harley, owing to ill health, has resigned from the chair of pathological chemistry at University College, London.

M. Forneau, head of the chemical division of the Pasteur Institute, has been elected a member of the Paris Academy of Medicine in the section of pharmacy.

The seventy-second annual meeting of the Paleontographical Society was held on April 25. Mr. Henry Dewey, Dr. F. L. Kitchin, Mr. W. P. D. Stebbing and Mr. Henry Woods were elected new members of council. Dr. Henry Woodward, Mr. Robert S. Herries and Dr. A. Smith Woodward were reelected president, treasurer and secretary, respectively.

The British list of New Year honors, the publication of which has been delayed by circumstances arising out of the armistice, was issued on April 27. *Nature* selects the following names of workers in scientific fields: *Baronet:* Dr. Norman Moore, president of the Royal College of Physicians. *Knights:* Mr. R. T. Blomfield, past president of the Royal Institute of British Architects; Lieutenant-Colonel J. M. Cotterill, C.M.G., consulting and late acting surgeon, Edinburgh Royal Infirmary, and lecturer in clinical surgery, Edinburgh School of Medicine; Professor Israel Gollancz, secretary of the British Academy since its foundation; Professor R. A. Gregory, chairman of the organizing committee, British Scientific Products Exhibition; Mr. H. J. Hall, organizer under the Ministry of Munitions of the section dealing with the production of fertilizers; Dr. Edward Malins; Mr. J. H. Oakley, president of the Surveyors' Institution; Professor W. Ridgway, professor of archeology, University of Cambridge; Dr. C. S. Tomes, F.R.S., and Dr. T. J. Verrall, chairman of the Central Medical War Committee.

The British Medical Journal writes: "The Council of the British Medical Association has asked the president, Sir Clifford Allbutt, K.C.B., F.R.S., to accept a portrait of himself as a gift from members of the medical profession, and he has consented to give sittings for the purpose to an artist of eminence. Sir Clifford Allbutt has been president of the association since August, 1914, and has on

many occasions shown the deep interest he takes in its work. Age sits lightly upon him; he took an active part in the recent most successful Special Clinical and Scientific Meeting in London, and will be in the chair at the annual meeting to be held at Cambridge in 1920. Sir Clifford Allbutt has been Regius professor of physics in the University of Cambridge since 1892. So great is the respect, and, if we may be permitted to say, the affection, in which he is held by all ranks of our profession, that very many will without doubt wish to join in this presentation to him. It has accordingly been decided to limit the amount of individual subscriptions to one guinea. The treasurer of the British Medical Association is now prepared to receive subscriptions of this or lesser amount from any member of the profession. Cheques should be made payable to the 'Sir Clifford Allbutt Presentation Fund,' and crossed London county, Westminster, and Parr's Bank."

SIR JOHN ROSE BRADFORD will give a discourse at the Royal Institution of Great Britain on Friday, May 30, on filter-passing virus in certain diseases. On the following Friday Sir Ernest Rutherford, who has recently succeeded Sir J. J. Thomson as Cavendish professor of experimental physics at Cambridge, will deliver a discourse on atomic projectiles and their collisions with light atoms.

THE Cornell University Medical College conducted during the month of May a series of special lectures, as follows: May 6, Dr. Burton J. Lee, "Surgery of the breast;" May 3, Dr. Lee, "Military surgery, particularly blood transfusion;" May 20, Dr. Henry H. M. Lyle, "Military surgery, organization at the front;" May 27, Dr. George W. Hawley, "Military surgery, compound fractures."

MAJOR JOSEPH LEIDY, M.R.C., U.S.A., medical director, Department Gas Defense, delivered an address, illustrated with lantern slides, on "Poison Gas in War" before the Historical Society of Pennsylvania on May 12.

PROFESSOR JOHN C. MERRIAM, of the University of California, acting chairman of the National Research Council, delivered an address before the Washington Academy of Sciences on May 15, on "Cave hunting in California." The address was illustrated with lantern slides.

DR. WILLIAM E. CASTLE, of Harvard University, gave during Health Promotion Week at Northwestern University three free public lectures on genetics and eugenics. The subjects of the lectures were as follows: May 14, "Heredity and health," illustrated by lantern slides. May 15, "Principles of race improvement," illustrated by lantern slides. May 16, "Can we breed a better human race?"

DR. JOSEPH JACOBS recently presented to the Crawford Long Infirmary, on the campus of the University of Georgia, Augusta, a life size portrait of the late Dr. Crawford W. Long, discoverer of surgical anesthesia.

WALTER GOULD DAVIS, director of the Meteorological Bureau of Argentina for many years before 1915, when he resigned from that position, died on April 30 in Danville, Vt., where he was born in 1851. His earliest scientific work was in civil engineering, especially in railroad surveying through the White Mountains. While still a young man he went to Argentina as assistant to Dr. Benjamin Apthorp Gould, director of the astronomical observatory at Cordoba, and later became director himself. From Cordoba he was transferred to Buenos Ayres, and placed at the head of the National Weather Bureau, which he organized and built up. His work in this office gave the Argentine Meteorological Service a high scientific rank, and won its director an international reputation.

ALEXIS ANASTAY JULIEN, curator in geology at Columbia University from 1897 to 1909, died on May 7, aged seventy-nine years.

A. MCHENRY, the Irish geologist, died on April 19. He was for more than forty years on the staff of the Geological Survey.

DR. L. S. DAUGHERTY, for sixteen years professor of biology in the State Normal School, Kirksville, Missouri, and later in Missouri

Wesleyan, author of "Principles of Economic Zoology," died on February 28.

Fernand Priem, the French paleontologist, has died at the age of sixty-two years.

The deaths are announced of the Danish astronomer, Hans Emil Lau, and of A. M. Liapounoff, professor of applied mathematics at the Academy of Petrograd.

We learn from *Nature* there was held recently a conference of chemists in Paris attended by Professor Chavanne (Belgium), Professors Moureu and Matignon, M. Kestner and M. Poulenc (France), Senator Paterno and Dr. Pomilio (Italy), Mr. Henry Wigglesworth, Col. Norris and Dr. Cottrell (United States), and Sir William Pope, Professor Louis and Mr. Chaston Chapman (Great Britain). It was decided to form an inter-allied confederation for pure and applied chemistry which should organize permanent cooperation between the various countries, and coordinate scientific and technical knowledge as well as contribute to the advancement of chemistry in its fullest extent. The inter-allied council is to consist at the moment of six representatives from each of the nations mentioned above. The first meeting, will be held in London on July 15–18, when the inter-allied council will be the guests of the Society of Chemical Industry. For the time being the secretary of the inter-allied federation will be M. Jean Gerard, 49 rue des Mathurins, Paris. Particulars of the London meeting can be obtained in due course from Dr. Stephen Miall, 28 Belsize Grove, N. W. 3.

The Salters' Company has established an Institute of Industrial Chemistry to assist in promoting the training and welfare of students who desire to pursue an industrial career, and of workers engaged in the chemical industry. The London *Times* states that during the present interval of reconstruction the committee of the institute is awarding several post-graduate fellowships to young chemists whose training has been interrupted by some form of war service, and who consequently require to devote an appropriate period to further study, in order to equip themselves for an industrial post in a manner calculated to render them useful to their future employers. In pursuance of this policy, fellowships have been awarded to Messrs. W. H. Gough, B.Sc., and W. A. Haward, B.Sc. (Imperial College of Science and Technology), Captain L. J. Hudleston, B.Sc. (Reading University College), Lieutenant K. H. Saunders, M.C., and Mr. Gordon M. Wright, B.Sc. (University of Cambridge), Mr. P. N. Williams, B. Sc. (University of Liverpool), and Lieutenant Dudley C. Vining (Finsbury Technical College), who will continue their training at the university college indicated. Substantial support in the work of the institute has been received from firms prominent in the chemical manufacturing industry.

Through the generosity of the late Mr. Wm. H. Graflin, of Baltimore, a scholarship, to be known as the Graflin Scholarship, and three assistantships for the year 1919–20 have been established in the department of chemistry of the Johns Hopkins University. The Graflin Scholarship will be awarded annually to a candidate having a training equivalent to that leading to the Ph.D. degree and who therefore has had experience in research. It may be awarded twice to the same candidate. The holder of the scholarship will receive $1,000 a year and will be expected to devote his entire time to research. The three research assistantships each pay $750 a year and are open to chemists having the equivalent of a Ph.D. degree. The holder of a research assistantship will not be required to do any formal teaching but will be given the opportunity to devote his entire time to research and to assist in the direction of research. Applications for the above position for the year 1919–20 should be sent to the department of chemistry, Johns Hopkins University, 321 Druid Hill Avenue, Baltimore, Md., before August 1.

The University of Arizona through the Arizona Bureau of Mines is offering an eight weeks' summer course in field geology and mining, to begin July 1 and end August 18, 1919. The work will be under the supervision of Professor C. J. Sarle, of the department of

geology, and Professor M. Ehle, department of mining of the College of Mines and Engineering. It will include geodetic and topographic surveying, mapping of areal geology, making of geologic cross-sections, studying of mines or prospects and undeveloped ore deposits, and making mine examinations and reports. The region selected lies in the connected Chirichua and Dos Cabezas Mountains, fault-block ranges in southeastern Arizona. The choice of the field was based upon the varied structural features, diversity of formations and their great range in age, rich in metallization and mining development, ideal summer climate, fine camping sites, and accessibility. Maps and bulletins covering the area worked will be prepared by the professors in charge and will be published by the Arizona Bureau of Mines. Such students as are especially well prepared may collaborate on reports, and data secured may also be worked up into theses. The university will furnish a full field equipment, including housing, camp cook, surveying instruments and conveyances. The class is limited to sixteen, and is open to students of all universities and colleges who have had at least a course in physical and historical geology and mineralogy. Applications should be received by June 1. For further information address the director, Arizona Bureau of Mines, Tucson, Arizona.

UNIVERSITY AND EDUCATIONAL NEWS

WE learn from *Nature* that Mr. Lawrence Philipps has offered University College, Aberystwyth, the sum of £10,000 to found a plant-breeding institute for Wales in connection with the agricultural department of the college. He has guaranteed a further sum of £1,000 per annum for ten years towards the maintenance of the institution. The governors of the college have appointed Mr. R. G. Stapleton, who was for some years connected with the college as advisory botanist, to a chair of agricultural botany and to the directorship of the new institution.

THE first school of practical forestry in Scotland has been opened at Birnam, in Perthshire. The school building that has been erected at Birnam is itself an example of what can be done in forestry, being entirely built of home-grown wood. At present the school has twelve students. The course will cover two years and will consist of both practical work and lectures. The Duke of Athol has placed his woodlands at the board's disposal for practical instruction and the aim of the school is both provision of technical instruction and the furnishing of openings for discharged service men.

WILLIAM D. ENNIS, who has since his release from military service been acting professor of mechanical engineering at Columbia University, has been appointed professor in marine engineering in the post-graduate department of the United States Naval Academy.

DR. TOBIAS DANTZIG and DR. G. A. PFEIFFER have been appointed instructors in mathematics at Columbia University.

DR. JAMES DREVER has been appointed Coombe lecturer in psychology at the University of Edinburgh.

PROFESSOR F. SODDY, F.R.S., of the University of Aberdeen, has been elected to the second chair of chemistry recently established in the University of Oxford.

DISCUSSION AND CORRESPONDENCE

ON THE AURORAL DISPLAY OF MAY 2, 1919

TO THE EDITOR OF SCIENCE: The following observations of the auroral flash visible in Washington on the nights of May 2 and 3, 1919 and observed by us between the hours of 3:30 A.M. and 5 A.M. may be of sufficient interest for record. There is one point mentioned later which to us seemed very striking.

The general appearance of the phenomenon reminded one of a searchlight display. The streaks of lighted sky were at times very similar to the streaks of diffused light along the paths of searchlight beams. The brightness of the auroral streaks was comparable in brightness to that of the path of the searchlight beam on clear nights when seen from a great dis-

tance. (This brightness is of the order of 20 microlamberts for a 24-inch 75-ampere searchlamp near by). The streaks appeared over a region of the sky extending some 20 degrees to either side of Polaris and from the horizon up to Polaris and slightly higher. The individual streaks varied in width from several degrees to a fractional part of a degree. There were a few streamers that extended upward very much farther than the others. These did not lie symmetrically with respect to Polaris but to the eastward were more numerous. Over these streaks of lighted sky as background appeared a wavering sheet of lighted sky of lower brightness, whose undulations seemed to travel from the horizon upward. When the brightness of the streaks was great enough the light was a decided green, otherwise it appeared a faint greenish blue.

The point of greatest brightness during this display was a small patch of sky situated in one of the streaks slightly to the eastward of the vertical line passing through Polaris. This patch was probably 2 degrees wide and very much less in vertical thickness. Its distance from the horizon was probably between 5 and 10 degrees.

This gave an exact semblance of a searchlight beam piercing a cloud. The brightness of this patch was many times the brightness of the streak in which it was situated, and was of a very striking green color. We had hoped to photograph this, but during the few moments while the camera was being prepared it disappeared together with most of the streaks. The streaks reappeared quite distinctly but this bright patch did not.

Other data which we chance to have on record for other work are:

Temperature 11:45 P.M. 16° C.

Temperature recorded nearest the time of appearance of Aurora (2:50 A.M.) 15°.

Winds—practically none.

Sky—generally clear.

Enoch Karrer,
E. P. T. Tyndall

Bureau of Standards,
Washington, D. C.,
May 9, 1919

To the Editor of Science: I have just come in from viewing what to me was a remarkable auroral display. Earlier in the evening, about ten o'clock, while walking from a friend's house, I saw the ordinary display of an arch of light across the north with streamers extending to a considerable height. This lasted for about half an hour. Perhaps a quarter of an hour after its disappearance I noticed a long band or cloud of dim light across the sky which I at first took to be an after-image on the retina. But the image did not move with the eye, and soon it became quite bright. This display extended from a point on the western horizon, about 25° or 30° north of west, high up across the sky over to a point on the eastern horizon about 20° south of east. The band of light widened as it left the horizon, at the highest point being about 15° wide, extending from declination 55° to about 70° declination.

Near the horizon the light was quite bright, growing gradually dimmer as it slowly widened out towards the highest point. At the westerly end the south side of the band was cut off sharply by a nearly vertical line. Elsewhere the boundary was not very sharply drawn. In about fifteen minutes the light began to fade, but before entirely disappearing it brightened up again nearly as bright as before. Soon after, it faded again, entirely disappearing in the upper portion. For fifteen minutes or so the two ends remained, extending to a height of about 45° from the horizon. The eastern end broke into two parts as if cut in two. The lower part shot up from the horizon like a streamer, inclining a little to the south, the sharp demarcation of the south side of the western end persisted. The two ends remained stationary during the entire time. At the second maximum of brightness the upper part moved farther north extending nearly to Polaris. During the display none of the ordinary auroral display across the northern horizon was to be seen. If there was any it was too faint to be seen in the vicinity of street lights.

I have seen a number of remarkable auroras but have never before seen or heard of anything like this one. The bright band of light extend-

ing from north of west clear across the sky, almost to the zenith, down to south of east, made a very beautiful and impressive sight. It was very much admired by those I called out to see it.

I should like to know if this display was noticed in other parts of the country and if others have observed similar phenomena at other times.

G. IRVING GAVETT
UNIVERSITY OF WASHINGTON,
SEATTLE, WASH.,
May 2, 1919, at 11:30 P.M.

THE HISTORY OF SCIENCE

TO THE EDITOR OF SCIENCE: I have read with much interest Dr. Felix Neumann's article published in your number of April 4 and I heartily agree with him that the creation of a new section of the American Association for the Advancement of Science, to be devoted to the history of science, would be most desirable.

I think it is hardly necessary to demonstrate the necessity of such historical studies, but I beg to submit the following arguments in support of Dr. Neumann's proposition.

1. The history of science has a real and full signification only for scientifically trained people, and it appeals equally to scientists of all kinds, hence it is natural that its study be promoted by such an association as the American Association for the Advancement of Science.

2. Such historical studies, however, are very different from scientific studies proper; they require a special turn of mind, a special equipment and special methods without the use of which no high standard of accuracy can be obtained, hence it is necessary that they be promoted by an independent section.

3. Such independent sections have been organized many years ago by the Versammlung deutscher Naturforscher und Aerzte and by the Società italiana per il Progresso delle Scienze, notwithstanding the fact that societies exclusively devoted to the history of science exist both in Germany and in Italy.

GEORGE SARTON
CARNEGIE INSTITUTION OF WASHINGTON

QUOTATIONS

THE OBSTRUCTION OF MEDICAL RESEARCH IN GREAT BRITAIN

THE passage through a standing committee of the House of Commons, without amendment, of the so-called "Dogs' Protection Bill" has rudely awakened to a danger too lightly regarded, every one who in any way realizes the importance of the issues involved. In the *Times* of April 8, Sir Philip Magnus tells how the past master of parliamentary tactics who introduced the bill was able to bring it up for second reading unexpectedly, at the close of a sitting and to secure, almost without discussion, its reference to a standing committee. The committee was aparently composed in the usual way, mainly of members selected with reference to their political affiliations, without any regard to their competence to deal with an essentially scientific question; three or four medical members were added and a contingent of nominees of the members in charge of the bill, who could be trusted to know his own supporters. In two short sessions, and with the help of the closure, the bill passed through this committee without amendment. The next stage will be that it will come before the House for third reading at the next opportunity, which may occur any week.

The effect of the bill, if it should pass into law, is plain enough. It would render any one who made an experiment of any kind upon a dog liable to prosecution. Its enactment would cripple progress, so far as this country is concerned, in some of the most important fields of medical investigation. The whole weight of informal opinion must be brought to bear to prevent such a calamity. Letters of protest and warning have appeared in the *Times* of April 5, 7, 8 and 9, from Sir Edward Sharpey Schafer, Dr. Thomas Lewis, Dr. Leonard Hill, Professor Langley and Professor Starling. The *Morning Post* of April 7 published under the heading, "A Blow to Medical Science," an admirable statement of the case against the bill. The lay press is fulfilling a valuable function in thus enlightening general opinion.

So far as our own readers are concerned, we are preaching to those who need no conver-

sion, but it may be doubted whether the medical profession as a whole has fully realized its responsibility to the public in this matter. The unscrupulous agitation, which has at length come so perilously near to achieving an instalment of its purpose, has been aided by the prevalent ignorance of the public, and by the power of appeal to a sentiment which is strongly developed in all Englishmen—in medical men as in others. The dog has established a proper claim on man's sympathy and affection, and the public have the right to inquire whether its use for experiment is essential for the progress of medical science, and to be satisfied that the practise involves no significant amount of pain. The materials for assurance on both points are in the hands of every medical man who has thought about the matter and has made himself acquainted with readily accessible facts. The Research Defence Society has done valuable work, but the ordinary man or woman has more confidence in the friend with expert knowledge than in the publications of societies. He has the right to expect that his feelings, harrowed by an insistent campaign of misrepresentation, shall not be treated merely with good-humored tolerance. The plain facts of the case are easily made clear, and would be accepted by the vast majority of laymen from the medical advisers whom they trust. If lay opinion had not been left so much at the mercy of a mendacious agitation, it is incredible that even a tired and apathetic remnant of the House of Commons would have allowed this bill to pass its second reading almost without discussion.—*The British Medical Journal.*

SCIENTIFIC BOOKS

The Game Birds of California. Contribution from the University of California, Museum of Vertebrate Zoology. By Joseph Grinnell, Harold Child Bryant and Tracy Irwin Storer. University of California Press, Berkeley, 1918. Large 8vo. Pp. i–x + 1–642, 16 colored plates and 94 text-figures. Price, cloth, $6.00 net.

While the conservation of the wild game of a state is one of the most important problems with which the commonwealth has to deal, it is rarely that it receives the expert attention that it should and that is usually possible. Too often the fish and game committees of the legislature and the game commissions are composed of men who are merely sportsmen, interested of course in the preservation of game according to theories that they as shooters of game have conceived, but not cognizant of the more fundamental principles which only the trained zoologist or conservationist understands.

California is to be congratulated upon securing the services of such competent zoologists as Dr. Grinnell and his associates at the University of California—Dr. Bryant and Mr. Storer—in preparing this admirable volume upon the game birds of the state.

The plan of the work is well conceived and is carried out with a painstaking regard for accuracy and uniformity of treatment. Under each species we have full descriptions of the various plumages, with special emphasis on "marks for field identification," the call notes, nest and eggs are then described and a statement of the distribution of the species in general, as well as in California, is added. Then follows a general account of the life history of the bird, its food, actions, etc., with now and then pertinent extracts from the works of various authors. This systematic portion of the work naturally forms the bulk of the volume, and is a repository of information which will benefit readers far beyond the boundaries of California, since the list of game birds of the various states of the union includes many of the same species, and Dr. Grinnell and his associates have spared no pains in gathering together all the information that was to be had. The published literature and manuscript records have been exhaustively studied and the museums of the whole country have been visited in order to secure descriptions of the various plumages that game birds present at different ages and seasons.

The earlier chapters of the work discuss the more general problems of game preservation and their careful study by those framing game legislation in all parts of the union will be well worth while.

The tremendous destruction of game in California is well known, but few probably realized its extent until the actual figures were placed before them. When we read that 72,000 ducks were handled by one Game Transfer Company at San Francisco in the season of 1910–11 and 20,000 geese by another company in the preceding year, while the estimated number of these birds sent to market has decreased from 350,000 in 1911–12 to 125,000 in 1915–16, we can readily understand why there is serious apprehension as to the future of the game supply!

Ducking clubs and their influence upon the preservation of wild bird life come in for very careful consideration. It is freely granted that they provide and maintain better feeding grounds for the ducks while additional food is supplied in the form of "bait." Indiscriminate and illegal gunnery is prevented on the areas under the club's control and hunting is limited to a few days a week and to relatively few shooters. At other times the grounds form an admirable refuge for the birds.

On the other hand, the attractiveness of the protected grounds concentrates the duck population in a limited area where a very heavy toll is levied, and the shooting is done by highly trained marksmen with the best of weapons, and large annual bags result. And the authors consider that the extermination of the ducks is far more rapid than when they remain scattered over wide areas, and are hunted by gunners of varying skill.

Other topics connected with conservation are discussed in the same careful manner, while the treatment of the life histories of the various species is very full. Turning to the chapter on the Valley Quail we find, besides the description of the bird, nest, habits, etc., evidence to show that the males act as sentinels; while it is pointed out that the species lays more eggs than any other game bird and suffers corresponding mortality and means of controlling the latter are suggested. The relation of the species to agriculture is considered carefully and also the problem of hunting this bird for the market.

This is a work of reference which should be in every western library and one that should be available to conservationists the country over.

The publishers have done their part of the work admirably and the result is a very handsome volume, beautifully illustrated by sixteen color plates of game birds from paintings by Louis Agassiz Fuertes and Major Allan Brooks.

W. S.

SPECIAL ARTICLES

THE SUSCEPTIBILITY OF A NON-RUTACEOUS HOST TO CITRUS CANKER

Citrus canker is a disease recently introduced into the Gulf states from Japan. At present attempts are being made to eradicate this disease entirely in those states, by burning trees on which infections are found, thus eliminating the sources of new infection.

The senior writer has shown[1] that citrus canker is not closely confined to the species of *Citrus* as hosts but affects plants of a large number of other genera of the Rutaceæ. It is believed that this work has been corroborated by workers in the United States.

More recently inoculations of plants outside of the Rutaceæ have been attempted. The lansones (*Lansium domesticum*) of the Meliaceæ, a tree cultivated in the Philippines for its edible fruit, was the first non-rutaceous plant employed. Needle punctures made through a suspension of *Pseudomonas citri* placed upon the actively growing midribs of leaves and upon the petioles and main stems of this plant have produced swellings which later cracked and erruptions of tissue have resulted. In some cases the swellings have been surrounded with the yellow halo typical of canker upon citrous hosts. Control inoculations made with river water under the same conditions have remained negative.

Pseudomonas citri has been reisolated from such lesions, the numbers of colonies in the isolation plates indicating that there was abundant reproduction of the organism in the lansones tissue.

[1] "Further Data on the Susceptibility of Non-Rutaceous Plants to Citrus Canker," *Journal of Agricultural Research*, Volume 15, No. 12, December 23, 1918.

Inoculations have been repeated several times and each time there was produced a reaction not shown in the controls. These results have been obtained both on potted trees and trees growing under field conditions. The experimental conditions were at the optimum for canker development with very favorable moisture environment and vigorously growing host plants. The results warrant the statement that *P. citri* upon stem tissue of *Lansium domesticum* produces a reaction not evidenced in control inoculations.

These results are recorded as of possible interest in throwing new light on the character of the canker organism. It is conceivable that a chain of circumstances in the field might produce extreme optimum conditions that would lead to infection of highly resistent host plants, which from observation under ordinary conditions would be regarded as immune. Lesions on such hosts then would be capable of serving as sources of reinfection to citrus plants.

H. Atherton Lee,
Elmer D. Merrill

Bureau of Plant Industry,
Washington, D. C.,
Bureau of Science,
Manila, P. I.

THE NEBRASKA ACADEMY OF SCIENCES

The program of scientific sessions of the meeting held in Lincoln on May 2 and 3, was as follows:

FRIDAY, MAY 2

Afternoon Session

The algal flora of some of the sandhill lakes: Elda R. Walker.

Corn adaptation studies: F. D. Keim.

The development of Cyathus and Crucibulum: Leva B. Walker.

Stem rust control through barberry eradication: E. Mead Wilcox.

Root habits of plants of prairies, plains and sandhills: J. E. Weaver.

Notes on Nebraska trees: R. J. Pool.

Bacteriology and pathology of influenza: H. B. Waite.

The seasons in 1918 from the standpoint of the zoologist: Robert H. Wolcott.

The mental testing for college entrance: Rufus C. Bentley.

Validity of the intellectual tests: Charles Fordyce.

The need of community educational and human welfare get-together clubs: G. W. A. Luckey.

Future world war: A. E. Sheldon.

Projection charts: H. G. Deming.

The state academies of science: D. D. Whitney.

Evening Session

The annual presidential address, by David D. Whitney, professor of zoology, University of Nebraska. Subject: "Recent progress in the study of heredity."

SATURDAY, MAY 3

Morning Session

Place names in Nebraska: Susan Harmon.

A coin display case for museums: E. E. Blackman.

Radioactivity in the high school: Floyd Doane.

A plea for elementary astronomy in the schools: W. F. Hoyt.

A new way of tracing cardioids: William F. Rigge.

Some electrical phenomena connected with rainfall: J. C. Jensen.

What weather makes a great wheat yield: G. A. Loveland.

The two great observatories in California: G. D. Swezey.

On a phase of chemistry in modern warfare: C. J. Frankforter.

Fat substitutes: Mary L. Fossler.

Automobile accidents: O. W. Sjogren.

Notes on personal experiences in the potash fields: J. E. Murray.

Oil shales of Wyoming: E. F. Schramm.

Potash surveys: G. E. Condra.

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SCIENCE

FRIDAY, MAY 30, 1919

CONTENTS

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THE LESSONS OF THE PANDEMIC

THE pandemic which has just swept round the earth has been without precedent. There have been more deadly epidemics, but they have been more circumscribed; there have been epidemics almost as widespread, but they have been less deadly. Floods, famines, earthquakes and volcanic eruptions have all written their stories in terms of human destruction almost too terrible for comprehension, yet never before has there been a catastrophe at once so sudden, so devastating and so universal.

The most astonishing thing about the pandemic was the complete mystery which surrounded it. Nobody seemed to know what the disease was, where it came from or how to stop it. Anxious minds are inquiring to-day whether another wave of it will come again.

The fact is that although influenza is one of the oldest known of the epidemic diseases, it is the least understood. Science, which by patient and painstaking labor has done so much to drive other plagues to the point of extinction has thus far stood powerless before it. There is doubt about the causative agent and the predisposing and aggravating factors. There has been a good deal of theorizing about these matters, and some good research, but no common agreement has been reached with respect to them.

The measures which were introduced for the control of the pandemic were based upon the slenderest of theories. It was assumed that the influenza could be stopped by the employment of methods which it was assumed would stop the other respiratory diseases. This double assumption proved to be a weak reed to lean upon. The respiratory diseases as a class are not under control. They constitute the most frequent cause of death, yet it is not known how they can be prevented.

Three main factors stand in the way of pre-

vention: First, public indifference. People do not appreciate the risks they run. The great complexity and range in severity of the respiratory infections confuse and hide the danger. The infections vary from the common cold to pneumonia. They are not all separate entities by any means. An attack which begins as a coryza or rhinitis may develop into a pharyngitis, tonsilitis, laryngitis, bronchitis or pneumonia. The gravity increases with the progress toward the lungs. The infection sometimes seems to begin in the chest, sometimes in the throat, sometimes in the head. It may stop where it started or pass through several phases. This is the story of the common cold. It is generally more discomforting than dangerous. Most people get well without skillful treatment, or indeed any great interference with business. No specific virus is known to produce it.

There is another group of diseases, a more unusual one, which is often at first confused with the foregoing. This includes the specific infections such as diphtheria, measles and scarlet fever. Influenza is in this class. The symptoms at the beginning may be identical with those of the common cold and the true nature of the disease escape notice until the patient shows unmistakable and alarming symptoms. By that time other persons may be infected.

The second factor which stands in the way of prevention is the personal character of the measures which must be employed. The enteric infections can be controlled by procedures of a general sort which impose no great restriction upon the conduct of the individual, but this is not true of the respiratory infections. The waste products of influenza containing the infective virus are not deposited in a vessel or sewerage system where they can be properly dealt with as in typhoid. The excreta of the nose and throat are projected into the air and allowed to pollute the hands, the food, the clothing and, in fact, the entire environment of the infected person. This is done unconsciously, invisibly, unsuspectingly. General methods directed against this kind of germ distribution must necessarily be of limited value.

It is an epidemiological point of great interest that the kind of preventive measures which must be taken in order to control the respiratory infections devolve upon the persons who are already infected, while those who are liable to contract the disease can do little to protect themselves. The burden is placed where it is not likely to be well carried. It does not lie in human nature for a man who thinks he has only a slight cold to shut himself up in rigid isolation as a means of protecting others on the bare chance that his cold may turn out to be a really dangerous infection.

Third, the highly infectious nature of the respiratory infections adds to the difficulty of their control. The period of incubation varies considerably; in some infections it may be as short as a day or two. And the disease may be transmissible before the patient himself is aware that he is attacked.

This list of the obstacles which stand in the way of controlling the respiratory diseases may fittingly be closed by remarking that healthy persons often carry about in their persons the germs of disease, thereby unconsciously acting as a continuing danger to themselves and a menace to others. It is not to be wondered at, therefore, that of all the things which were done to stop the spread of influenza, nothing seems to have had any material effect upon it.

This may all seem very discouraging but it need not depress anybody. The control of typhoid once seemed an impossible task. To rightly measure a difficulty is often the first step toward overcoming it.

What is said here of the influenza pandemic is put forward only as the writer's view at the present time. Nobody can now speak authoritatively upon this subject. When all the facts are brought together some of the ideas which are held to-day may be found to require modification. We are still too close to the event to fully measure it. Individual researches and the efforts of innumerable workers, must be reported and evaluated. The

mass of statistical data which has accumulated in cities, towns, camps and hospitals must be assorted, tabulated and studied before it will be possible to speak with anything like finality as to the efficacy of the measures of control employed.

Until this is done, it will be impossible to give the number of persons attacked, their age, sex, condition and race, the complications and sequelæ of the disease, much less the relations which these facts bear to the preventive measures. This work is now engaging the attention of many experts. Public health officers, skillful workers in bacteriology and pathology and able clinicians who have had opportunity to study the disease intensively are making their reports. It will be months and perhaps years before the records of all the scientific study connected with the pandemic are brought to a conclusion.

A good deal may confidently be expected of the work which has been done from so many angles and in so many places. How far the mysteries which have obscured the true nature of influenza for so many years will be cleared up must be left for time to show.

No disease is more difficult to study than pandemic influenza. It comes, it spreads, it vanishes with unexampled suddenness. It possesses such terrific energy that little time is afforded during its visitations in which to study it in a careful and painstaking manner. Both its total absence and its great prevalence stand in the way of its study.

But, it will be asked, is influenza entirely absent in the intervals between epidemics? Opinion is divided on this point. Some hold that pandemic influenza is a separate infection. Others think it is always with us. It does not ordinarily manifest such a fatal aspect as that recently seen, but many of the symptoms of the usual epidemic and the extraordinary pandemic influenza are the same. Perhaps the recent pandemic is best explained on the assumption that a particularly virulent type of the common infection was to blame.

All attempts at excluding influenza from a community seem to have failed. There is one and only one way to absolutely prevent it and that is by establishing absolute isolation. It is necessary to shut off those who are capable of giving off the virus from those who are capable of being infected, or vice versa. This is a very difficult procedure. First, it is difficult because it is impossible to discover all the virus producers. Second, it is difficult because it is impossible to know who are and who are not immune. Complete isolation is not feasible for entire cities nor for parts of cities, nor for individuals in cities. It is feasible for some small towns and villages, and some have tried it with success. The fact that in many instances the attack has been merely postponed by no means invalidates the principle.

It is natural to suppose that a phenomenon of such general nature as the influenza pandemic has had an equally general cause and the only cause which most people can think of as general enough to give rise to a world pandemic is one which possesses an atmospheric or terrestrial character. This is a very old conception and one which has survived all others so far as the general public is concerned. In one of its forms it is known as Sydenham's theory of epidemic constitution. In spite of the repeated statement that this theory has been discredited, there are many well-informed persons who believe as Sydenham did that there are general conditions beyond our knowledge which help to cause disease to assume a different aspect and prevalence in some years and at some seasons than at others.

As late as the pandemic of 1889–90 it was thought by many that the cause of the influenza outbreak was in some way connected with world conditions and quite independent of human intercourse. To-day there are some who think that the extraordinarily cold winter of 1917–18 followed by the hot summer was largely responsible for the recent pandemic. Others believe that the great war precipitated the plague. Not a few think that the infection was spontaneously developed in many places at about the same time. The arguments which have been made in support of

these suppositions are often ingenuous if not convincing. Unfortunately, they seldom stand the test of scientific analysis.

The weight of evidence now available indicates that the immediate cause of the great pandemic of 1918 was an infective virus which passed from person to person until it had spread all over the world. The method of spread is believed to have been the same as in other respiratory infections. The reasons for the belief that it was transmitted in this manner lies chiefly in the fact that the pandemic spread rapidly, and no more so, than people traveled from point to point.

Nobody so far has positively shown what the virus is, nor how it leaves or enters the body, nor at what period in the disease it may be transmitted to others. Some hold that the Pfeiffer bacillus is the causative agent, others believe that there is a filterable virus which acts independently or in conjunction with the Pfeiffer bacillus. Nearly all agree that the influenza and pneumonia were independent diseases and that the high fatality was due to a very remarkable reduction of resistance to the pneumonia brought about by the influenza. Being of the respiratory type, it is believed that the virus leaves the body by way of the nose and mouth. It is supposed to enter the body by way of the nose, mouth or eyes.

But, it may be asked, if the influenza and the Pfeiffer bacillus are always with us, why should the disease suddenly become so different from its ordinary type in respect to severity, infectivity and complications? Nobody has answered these questions.

There are various ways of replying to them. One is to assume that the infective poison was brought into civilized countries from some distant point where it originated. Another is to suppose that it developed locally. It is not possible to follow these theories through all their details here. The arguments are not convincing by any means. Certainly a complete explanation of the pandemic requires a demonstration of how the disease developed wherever that development took place.

The development of the disease was undoubtedly a complicated biological phenomenon. A virus was produced which was capable of overcoming the resistance of a large proportion of those who were exposed to it. Reductions in virulence are familiar occurrences in connection with infective poisons. Controlled attenuations have been at the foundation of a great deal of the best work in immunology since the time of Pasteur. Increases are less often observed, but it is a well established fact that a virus which has practically lost its pathogenic properties can be exalted to a high state of virulence by inoculating it into susceptible animals. The spontaneous recrudescences of virulent disease in epidemics which sometimes appear to have originated in mild epidemic infections suggest the same process.

Reasoning by analogy it would appear not unlikely that an influenza virus which existed somewhere, perhaps among persons who had become accustomed to it and had consequently gained a toleration to it, was introduced among others to whom it was a stranger and who were consequently particularly susceptible to it. This would naturally result in an outburst which might attain pandemic proportions.

The pandemic has shown among other things how widely and how quickly respiratory infections may travel. It has shown what an enormous interchange of germs takes place in the respiratory apparatus of those who live in cities and towns and villages. It is disquieting to find how readily and frequently the bacterial products of the sick gain entrance into the noses and mouths of other persons, but the facts must not be hidden if to acknowledge them will do any good.

The pandemic calls attention not only to the fact that there is an interchange of mouth germs wherever people meet, but it illustrates how frequently respiratory infections may occur to which little or no attention is given. Some people think that pandemics of colds occur from time to time which are almost as universal as was the recent influenza. Their pandemic character is not suspected because

they are so mild. A pandemic of influenza swept over the United States five months before the fatal wave but it attracted notice only in a few places.

The frequent presence of epidemics of colds affords the groundwork upon which other respiratory diseases should be studied. It has been well said by Sir Arthur Newsholme, Medical Officer of Health to the Local Government Board of England, that until the common respiratory infections are studied and controlled, it will be impossible to understand and manage influenza. With this opinion the present writer heartily agrees. The way to study influenza is to study the common cold. The place to study the common cold is a village or other circumscribed environment. The time to study it is now.

The great lesson of the pandemic is to call attention to the prevalence of respiratory diseases in ordinary times, to the indifference with which they are ordinarily regarded and to our present inability to protect ourselves against them. They are not amenable to control through sanitary works as are typhoid, malaria and so many other diseases. They must be controlled by administrative procedures, and by the exercise of appropriate measures of self protection.

Will there be another visitation? Nobody can positively answer this question. Influenza commonly sweeps in more than one wave over a country. America experienced an unmistakable, but mild, wave before the great one of September and October and since then there have been local disturbances corresponding to fresh outbreaks in many places. In England a new and alarming prevalence has been reported. It would not be surprising if there should be another pandemic in the United States.

The steps which should be taken to suppress the disease if it breaks out afresh are such as seem best for the maintenance of general health and protection from respiratory infections as a class. If doubt arises as to the probable efficacy of measures which seem so lacking in specificity it must be remembered that it is better for the public morale to be doing something than nothing and the general health will not suffer for the additional care which is given it.

First as to the things which it is desirable not to do. It is not desirable to close theaters, churches and schools unless public opinion emphatically demands it. It is not desirable to make the general wearing of masks compulsory. Patients should not be masked except when traveling from one point to another —they need air. Suspects should wear masks until their cases are positively diagnosed. Influenza patients should be kept separate from other patients. A case of influenza should be dealt with as though it was as contagious as a case of small-pox: there is danger in the presence of the sick, in his eating utensils, in his clothes and in the air into which he coughs and sneezes, if indeed these respiratory symptoms are present. He is to be regarded as much more seriously ill than his visible symptoms perhaps indicate.

It is worth while to give more attention to the avoidance of unnecessary personal risks and to the promotion of better personal health. Books have been written on the subject. The writer's idea of the most essential things to remember are embodied in the following twelve condensed rules which were prepared in September, recommended by the Surgeon-General of the Army and published by order of the Secretary of War to be given all possible publicity:

1. Avoid needless crowding—influenza is a crowd disease.

2. Smother your coughs and sneezes—others do not want the germs which you would throw away.

3. Your nose, not your mouth was made to breathe through—get the habit.

4. Remember the three C's—a clean mouth, clean skin, and clean clothes.

5. Try to keep cool when you walk and warm when you ride and sleep.

6. Open the windows—always at home at night; at the office when practicable.

7. Food will win the war if you give it a chance—help by choosing and chewing your food well.

8. Your fate may be in your own hands—wash your hands before eating.

9. Don't let the waste products of digestion accumulate—drink a glass or two of water on getting up.

10 Don't use a napkin, towel, spoon, fork, glass or cup which has been used by another person and not washed.

11. Avoid tight clothes, tight shoes, tight gloves—seek to make nature your ally not your prisoner.

12. When the air is pure breathe all of it you can—breathe deeply.

George A. Soper

Sanitary Corps,
U. S. A.

THE FREAS SYSTEM

Professor Thomas B. Freas, of the department of chemistry of Columbia University, has devised a scheme for the handling of apparatus and supplies that is not only novel and capable of indefinite expansion and adaptability to any chemical laboratory, but takes out of the hands of the instructional staff all handling of students' apparatus and chemicals.

The object of the Freas system is fourfold. First, to save the student's time by giving him all the chemicals and apparatus he needs at his bench, second, to insure pure and clean chemicals, third, to save of chemicals by giving the student just the amount needed, and doing away with the wasteful and sloppy side shelf reagents bottle, and fourth, to relieve the instructor of those details, and thus to enable him to devote his entire time to teaching and research.

Professor Freas has been too busy to publish an account of his scheme, and his extreme modesty prevents him undertaking the task, had he the time. As an interested outsider who has watched very closely how it works, at Columbia, I am perhaps better qualified than even he to speak of what seems to me the best scheme in America to handle this difficult problem. This scheme has been in operation in all divisions of chemistry at Columbia for the past seven years, and has given an ever increasing satisfaction to all concerned.

Many instructors spend most of their time handling supplies, although they are hired to teach, but they are not allowed to do so by the short-sighted and expensive policy of many institutions, which compel them to do work which a moderately paid employee could do just as well. One full professor of industrial chemistry of my acquaintance spends a greater part of his time supplying his students with chemicals, when an organized system could do it immensely better, leaving him free to devote his time to instruction.

In a modern chemical laboratory, and especially so in a large one, the problems are so numerous and so complex, that modern business methods require a sharp line to be drawn between the pedagogic and administrative affairs from those of up-keep maintenance, purchase, and handling of supplies. This eventually demands that the head of the department divest himself of all duties pertaining to the physical side of the laboratory, and turn that work over to the carefully selected and specially trained curator of supplies. If the administrative head has chosen wisely, he is not only relieved of an enormous burden, thus freeing himself for the instructional side of his profession, but the laboratory students and instructional staff gain by having this work done by an expert.

The success of the Freas system depends upon having some one man in the department, who is interested, selected to be the curator of supplies. He must have recognition, both in rank and salary, to attract a man of character, ability and training in laboratory needs. His time should be free for general guidance of others, by having several competent assistants, one in the office, one to handle chemicals and superintend the bottling, and one to handle all apparatus. In a small chemical department some of these divisions could be combined. The man or preferably a woman, in charge of the office, attends to all student accounts, keeps the books, takes dictation, and if the work is excessive has enough help to properly handle the work. The salary is about \$75 to \$100 a month, with two weeks' vacation, and one week sick leave during the year. This

applies to all the assistants in the stock system.

The man who handles the chemicals must have a steady working force, determined by the demands of the department. He is held responsible for the care and storage of all chemicals, and must notify the office of any needs. His main duty is, however, the bottling of liquid and solid reagents for student kits in ample time to have them ready at the beginning of each term. In a chemical department of 700 students this is an enormous task, when one course may require 140 different bottles per man. But with a good man in charge of several boys, and in rush times, extra student help, those chemicals can be put up, gathered together, in sets, and got ready for the student rush on the first day of the term. The man in charge need not receive over from $90 to $125 per month, and the boys over $10 a week. Student help may be used at an hourly remuneration, differing with the locality and the school.

The cost of this entire work is very small, when compared with the expense when this same work is done in the old way by a $3,000 a year man. The apparatus can be well handled by any capable woman with one or more assistants.

On checking out day the instructor assigns a student to a laboratory bench. The students take that slip to the office to see that all fees have been paid, and deposit for excess chemicals and breakage have been made. At the supply window he now receives and signs for his entire kit of chemicals and apparatus for one term. That material he arranges in his desk according to a plan which is given him. He locks his desk with his own padlock, which he can get from the stock-room if he wishes to do so, for a small sum. He now has his own chemicals and apparatus in his own individual locker, protected by his own padlock, to which he only has the key. The student is now solely responsible for breakage and loss, and his excess chemicals and breakage deposit protects the department against loss either from accident or by the student leaving the institution. Should he need extra chemicals or supplies, he can easily obtain these at the supply window by signing for the same. At Columbia the student receives as free allowance, the average chemicals needed for his particular course, and pays for excess chemicals, as being a loss due to his carelessness.

Many benefits arise from this arrangement, viz., individual responsibility for care of apparatus and chemicals; a much reduced consumption of chemicals, because the amount given is just sufficient for the experiment, plus a slight margin for unavoidable waste; all unnecessary movement is eliminated, as the student seldom has to leave his own bench, providing the laboratory is modern, and has at the benches individual student hoods; a doubling of the assigned amount of laboratory work, in the same time, due to a reduction of lost motion, and moving about the room, as exists under the old fashioned side reagent scheme, and finally, a relieving of the instructor of every duty, but that of teaching, which is probably the most important of all. A set of weights and a rough hand balance as a part of the kit avoids having common weights and balances, and the necessary walking and waiting one's turn to weigh under the old plan. The laboratory has no common property of any kind where theft, contamination, or injury is possible. The only exception is in the balance room, where two or more men are assigned to a quantitative balance, which is locked, and only assigned men have keys. Here responsibility can easily be fixed among a very few students.

Such a plan can only be possible when the curator of supplies has the sympathetic cooperation and support of the administrative head of the department. Many well meaning administrators of the old school pay little attention to the application of modern business methods to running a laboratory. Efficiency and expert ideas, when applied to that job are frowned on. It is the author's opinion that these men can not be regarded as progressive administrators, and it is his conviction that the department will go on in the same old way as back numbers, till some one

wakes up, or those who obstruct progress retire. There is no question, but that the chemical department which undertakes to run its laboratory on a strict business basis, will not only give their students more and better service for the same money, but will turn out better trained men than the laboratory with less up-to-date methods.

The College of the City of New York has partly adopted the Freas System, with such satisfactory results that we have almost doubled the amount of laboratory work given to the students per afternoon. The author feels that we should go the whole way and reap the full reward in more efficient work on the part of student and instructor. Starting is the big thing, but when once started, the plan will grow by its own intrinsic merits.

For a number of years past, the summer session of Columbia University has offered a course in laboratory organization and management, where the ideas I have here discussed have been carefully criticized by the students taking the course, mostly men and women of experience along the same line in other institutions.

Further details of this scheme will appear from time to time.

W. L. Estabrooke
Department of Chemistry,
College of the City of New York

ORGANIZATION MEETING OF THE AMERICAN SECTION OF THE PROPOSED INTERNATIONAL ASTRONOMICAL UNION

At the organizing meeting of the International Research Council held in Paris in November, 1918, it was decided to establish an International Astronomical Union, to continue and extend the work formerly conducted by such international astronomical organizations as the committee of the Carte du Ciel, the International Union for Cooperation in Solar Research, and similar bodies less formally constituted which dealt with various questions relating to astronomy and its applications. The International Research Council adopted a resolution requesting the National Academy of Sciences, or the corresponding organization in each of the countries represented, to take the initiative in organizing the section to represent that country in the International Astronomical Union. The tentative plan of organization of the American Section of the Astronomical Union, as approved by the president of the National Academy of Sciences, involved the representation of the various interests concerned as given below.

Upon the call of Dr. George E. Hale, acting for the National Academy of Sciences, the organization meeting for the American Section of the proposed Astronomical Union was held in the office of the National Research Council, Washington, D. C., March 8, 1919. The delegates who had been appointed by the presidents of the respective societies, or by the government, were as follows:

National Academy of Sciences—5.
H. D. Curtis acting for W. W. Campbell, G. E. Hale, A. A. Michelson, F. R. Moulton, Frank Schlesinger.

American Astronomical Society—10.
C. G. Abbot, S. I. Bailey, E. W. Brown, E. B. Frost, A. O. Leuschner, S. A. Mitchell, W. J. Humphreys, H. N. Russell, Joel Stebbins (absent, J. F. Hayford).

American Mathematical Society—3.
Frank Morley (two others to be appointed).

American Physical Society—3.
Henry Crew (absent, J. S. Ames, Theodore Lyman).

U. S. Naval Observatory—1.
J. A. Hoogewerff, accompanied by W. S. Eichelberger, Asaph Hall, F. B. Littell.

U. S. Coast Survey—1.
William Bowie.

The meeting organized by appointing Mr. Hale as chairman and Mr. Stebbins secretary. There followed a general discussion of the present international situation of science, and it was agreed that the union should take the place of previous international bodies in astronomy.

It was voted that the organization of the section should be considered temporary until

after the proposed conference in Paris in July, 1919.

The section voted that the chair appoint a committee on committees, to act temporarily as an executive committee, which should consider the general matter of business, appoint all committees, and add six additional members to the section. Appointed: W. W. Campbell, chairman; C. G. Abbot, E. W. Brown, Frank Schlesinger, Joel Stebbins, secretary. The committee added the following to the membership of the section: W. S. Adams, R. G. Aitken, E. E. Barnard, L. A. Bauer, Benjamin Boss, W. S. Eichelberger, W. J. Hussey, V. M. Slipher.

In regard to membership of enemy nations in the union, the section voted to adopt as representing the sentiments of the meeting the declaration of the Interallied Conference on International Scientific Relations, held at the Royal Society in London on October 9 to 11, 1918.

In regard to the admission of neutral nations to the union, the section voted that it be the sense of the meeting that nations which had been neutral in the war should be admitted into the International Astronomical Union on the conclusion of peace.

Mr. Schlesinger outlined the kind of astronomical work that requires international cooperation:

1. Work too extensive to be undertaken except by international cooperation; the Carte du Ciel, for example, or the plan of selected areas.

2. Undertakings in which there is a geographical necessity for international cooperation. Variation of latitude, longitudes, variable stars, continuous observation of solar phenomena, etc.

3. Matters of convention. Uniformity of nomenclature, notation and units. Examples, unit for stellar distances (four now in use), classification of spectra, use of probable or mean error or of average deviation, notation for celestial mechanics, notation for the reduction of photographic plates, etc.

4. The avoidance of duplication. Calculations for the national almanacs and for special ephemerides, such as comets, asteroids and variable stars. Astronomical abstracts, and news of new comets, variable stars, novæ, asteroids and the like.

The section discussed the various fields in astronomy in which committees should be formed to make report at another meeting of the section, which would give instructions to the delegates to the proposed Paris conference. The following committees were authorized by the section. The executive committee later made the appointments:

Committee on the Variation of Latitude: E. B. Littell, chairman; A. O. Leuschner, Frank Schlesinger. It was voted to ask the American Section of the International Geophysical Union to appoint a similar committee to confer and make a joint recommendation on the organization and method of handling the variation of latitude.

Committee on Standards of Wave-Length: Henry Crew, chairman; H. D. Babcock, Keivin Burns, W. W. Campbell, C. E. St. John.

Committee on Solar Rotation: C. E. St. John, chairman; W. S. Adams, Frank Schlesinger.

Committee on Eclipses: S. A. Mitchell, chairman; E. E. Barnard, H. D. Curtis.

Committee on Stellar Classification: H. N. Russell, chairman; Miss Annie J. Cannon, R. H. Curtiss.

Committee on Asteroids and Comets: A. O. Leuschner, chairman; E. W. Brown, G. H. Peters.

Committee on Almanacs: W. S. Eichelberger, chairman; E. W. Brown, R. H. Tucker.

Committee on Radial Velocities: W. W. Campbell, chairman; W. S. Adams, J. S. Plaskett.

Committee on Double Stars: R. G. Aitken, chairman; Eric Doolittle, W. J. Hussey.

Committee on Notation, Units and Economy of Publication: W. J. Humphreys, chairman; E. B. Frost, A. O. Leuschner.

Committee on Meridian Astronomy: Benjamin Boss, chairman; F. B. Littell, Frank Schlesinger.

Committee on Abstracts and Bibliographies: F. E. Fowle, chairman; H. D. Curtis, G. S. Fulcher.

Committee on Research Surveys: G. E. Hale, chairman; F. R. Moulton, Harlow Shapley.

Committee on Stellar Photometry: F. H. Seares, chairman; S. I. Bailey, F. C. Jordan, J. A. Parkhurst, Joel Stebbins.

Committee on Wireless Determination of Longitude: J. A. Hoogewerff, chairman; W. W. Campbell, J. J. Carty. This committee was requested to

study the feasibility of determinations of longitude by wireless at widely distributed stations, and report on what seems to be the proper time and method for such undertakings.

Committee on Solar Radiation: C. G. Abbott was asked to prepare a report on solar radiation.

Committee on the Spectroheliograph: The Mount Wilson Solar Observatory was asked to prepare a report on work with the spectroheliograph.

Committee on Reform of the Calendar: R. T. Crawford, chairman; W. W. Campbell, Harold Jacoby.

The question of delegates to the Paris meeting was left to the executive committee with power.

It was voted that the section offer to act in astronomical matters as the agent of the Division of Physical Sciences of the National Research Council.

Various other items of organization and scientific interest were discussed by the section at the morning and afternoon sessions, and in the evening, without formal action.

Joel Stebbins,
Secretary

SCIENTIFIC EVENTS

WAR RESEARCHES AT ST. ANDREWS UNIVERSITY

The University of St. Andrews, as reported by the London *Times*, has an interesting record of scientific service during the war, notwithstanding the fact that nearly all the men students and members of the staff of military age joined the fighting forces.

One of the early difficulties encountered by the British Admiralty and War Office was the provision of the scarce and costly kinds of sugar used in bacteriological work, which before the war had been prepared in Germany. The St. Andrews Laboratory was able to provide supplies for the British and Allied governments. In some cases the raw material itself was not to be had and new synthetic methods were devised for its production. The laboratory took part in preparing novocain and the corresponding intermediates, new processes being developed which have been adopted successfully on a manufacturing scale. Other synthetic drugs were also produced.

Professor Irvine, the director of the laboratories, acted as chemical adviser to the Department of Propellant Supplies, and for two years and a half was responsible for investigations relating to the manufacture of the materials needed for making cordite. During the last eighteen months of the war the laboratory carried on researches into chemical shellfillings.

The general work of the university was restricted during the war. But, owing to the large number of women students, the courses qualifying for useful professions were kept up with the help of senior officials, who undertook additional duties, and of extra women teachers.

Without knowing what financial help will be forthcoming from the government or the Carnegie Trust, it is impossible to say anything very definite on the developments which will take place in the new conditions created by the war. The endowments of St. Andrews leave little margin for expansion. But in general the policy of the university authorities is rather to increase the facilities for higher study and research in existing departments than to dissipate energies over a wider range of subjects. The training of graduates in research methods has been a special feature of the university for many years. It is hoped to extend the research laboratories and to enable research graduates in chemistry to combine with a training based on fundamental scientific principles a better knowledge of the necessities and methods of manufacture. A start has indeed already been made in this direction.

The university has felt justified in providing a Ph.D. degree open to graduates of British, colonial and foreign universities on terms similar to those which govern graduation in German universities. Students who wish to enter the university at a later age than usual are to be encouraged by the removal of the bar which they have hitherto met with in the preliminary examinations. In pure science the way is opened to more intensive specialization in the study for honor degrees. Syste-

matic courses of instruction in commerce have been instituted, leading to graduation.

The number of graduates and students who served with the forces during the war was about 800. Of these 96 have been killed or reported missing.

THE DEPARTMENT OF BACTERIOLOGY AND PUBLIC HEALTH IN YALE UNIVERSITY

AN outline of the work planned by the department of bacteriology and public health of Yale University, is given by Professor C.-E. A. Winslow in a recent number of the *Yale Alumni Weekly*. After consultation with the leading eastern universities a comprehensive program has been prepared leading to the Certificate in Public Health and the Doctorate in Public Health as well as to the Doctorate in Philosophy.

The Certificate in Public Health, which is to be conferred for one year of post-graduate study, is designed for two classes of students. On the one hand, young men and women who are just graduating from a college or technical school and desire to enter the field of public health, will be given a broad training in bacteriology, sanitation, health organization and vital statistics which will fit them for positions in health department laboratories and statistical bureaus, in bureaus of child hygiene or in other state and municipal departments. Outside of this district field of public service, experience has shown that those who hold the Certificate in Public Health may frequently find attractive positions as health executives, or as secretaries and field agents of various private organizations such as anti-tuberculosis societies, housing associations and the like.

A second class of students of maturer years for whom provision must be made, includes persons who have already specialized in some field related to public health, in medicine, for example, or sociology, or psychology or sanitary engineering, and desire to apply their special knowledge in the campaign for public health. The course for the Certificate in Public Health, with the freedom of election permitted to such mature students, is well adapted to give them a grasp of the general tendencies of the public health campaign and the special training they need in order to apply their knowledge in this field.

For students who desire to specialize in greater detail in certain of the various lines discussed above, opportunities will be offered to pursue a course of study of three years leading to the degree of Doctor of Philosophy, with opportunities for major specialization in problems of sanitation, epidemiology and industrial hygiene (with Professor Winslow); in public health bacteriology (with Professor Rettger); in the hygiene of the respiratory and central nervous system (with Professor Henderson); in immunology (with Professor Smith); in nutrition (with Professor Mendel); in problems of sanitary engineering (with Professor Barney); in problems relating to school and child hygiene (with Professor Gessel); and in vital statistics (with Dr. Dublin).

Both the Certificate in Public Health and the degree of Doctor of Philosophy are open to any college graduates, either men or women, provided they have pursued during their college course certain necessary prerequisites.

Beginning next autumn a new course of two years will be offered to medical graduates for which the degree of Doctor of Public Health will be conferred. It is believed that such a course, embodying not only class work but practical field work in a municipal health department, and the completion of study of a special problem designed to test and to develop the power of individual initiative, should furnish an ideal education for the public health administrator of the future.

BASE HOSPITAL NO. 21 OF THE WASHINGTON UNIVERSITY SCHOOL OF MEDICINE

ON April 20, 1919, Base Hospital No. 21, formed from the faculty of the Washington University school of medicine, St. Louis, landed in New York after 23 months service with the American Expeditionary Forces in France. The unit, in command of Major Fred T. Murphy, was in the first one thousand troops to go overseas; it was attached during the greater part of its service to the British forces and stationed at Rouen. Lieutenant Colonel Walter Fischel was in charge of the medical service. A part of the hospital, oper-

ating as Mobile Hospital No. 4 under the comand of Major W. B. Clopton, took part in the St. Mihiel and Argonne operations. Miss Julia Stimson, who went out as chief nurse, later became the head of the Nurses' Corps of the American Expeditionary Forces and has remained in France. Colonel Nathaniel Allison, orthopedic surgeon to the unit, was appointed orthopedic consultant of the American Expeditionary Forces. Major Sidney Schwab, neurologist, was transferred and placed in charge of Hospital No. 117 for war neuroses. Colonel Opie was detached from the unit to cooperate with Colonel Strong in the investigation of trench fever; he was afterwards placed in charge of the pneumonia commission in the Surgeon-General's Office. Colonel Murphy, after seven months service was appointed Medical and Surgical Director of the American Red Cross in France. He was succeed in command of the unit by Lieutenant Colonel Borden Veeder. The unit cared for over 62,000 patients during the eighteen months of its stay in Rouen.

THE CHEMICAL WARFARE SERVICE

The following letter has been sent by General Pershing to the chief of the Chemical Warfare Service:

American Expeditionary Forces
Office of the Commander-in-Chief
March 2, 1919

Colonel Edward N. Johnston,
Chief of Chemical Warfare Service,
American E. F., Tours.

My dear Colonel Johnston: Now that active operations have ceased and many of the personnel of the Chemical Welfare Service are returning to the United States, I desire to express to you and through you to all of your officers and enlisted men my appreciation of the valuable assistance they have rendered to the American Expeditionary Forces.

Upon our entry into the war we were faced with the problem of a new service in the organization of which the experience of our Allies was so new and so limited that there were few precedents to follow. The best brains and experience among students and teachers of chemistry were called into service, and by rapid establishment of gas schools and the aid of specially trained personnel, all combat troops were instructed in the necessary defensive measures against poisonous gas. The first gas regiment was trained and equipped, and rendered good service in the two American offensives of St. Mihiel and the Meuse-Argonne.

Due to the energetic cooperation of all ranks, much was accomplished in a very short time, for which it gives me great pleasure to extend to you all the thanks of your comrades of the American Expeditionary Forces. Will you convey this especially to Brigadier General Fries, whose enthusiasm and energy were such great factors in the successful organization and development of the service.

Sincerely yours,
John J. Pershing

THE DIVISION OF APPLIED PSYCHOLOGY OF THE CARNEGIE INSTITUTE OF TECHNOLOGY

Announcement is made of the following changes in the faculty of the division of applied psychology at the Carnegie Institute of Technology:

Lieutenant Colonel W. V. Bingham, executive secretary of the Committee on Classification of Personnel in the Army, returned to the Carnegie Institute of Technology on March first. He has been promoted to be dean of the division of applied psychology, which includes the departments of psychology, vocational education and personnel administration, and with which are affiliated the Bureau of Salesmanship Research and the Research Bureau for Retail Training.

Lieutenant Colonel Edward K. Strong, Jr., Ph.D. (Columbia), formerly professor of educational psychology at the George Peabody College for Teachers, has been appointed professor of vocational education and has already assumed his new duties as head of the department for the training of vocational teachers.

Major C. S. Yoakum, Ph.D. (Chicago), formerly director of the psychological laboratory at the University of Texas, has left the psychological section of the Surgeon General's Department to become associate professor of applied psychology.

Professor G. M. Whipple, who has been acting director of the Bureau of Salesmanship Re-

search during the absence of Colonel Walter Dill Scott on war service, has been released from these duties for work in educational research, through the return to Pittsburgh of Colonel Scott. At the close of the present academic year, however, Colonel Scott will devote himself to commercial practise as consultant on industrial personnel and will then give only a limited portion of his time to the Carnegie Institute of Technology.

Dr. Beardsley Ruml, who was on leave of absence with the War Department as head of the Trade Test Standardization Division of the Committee on Classification of Personnel, has resigned his position at Carnegie to enter commercial practise with the Scott Company.

SCIENTIFIC NOTES AND NEWS

A testimonial dinner to Dr. N. L. Britton, director of the New York Botanical Garden, given by the managers at the Metropolitan Club on the evening of May 7, was attended by men of science from all parts of the country. Dr. D. T. MacDougal, director of the Desert Laboratory of the Carnegie Institution of Washington acted as toastmaster, and speeches reviewing the history of the organization of the garden by Dr. Britton twenty-three years ago, and of his widely inclusive and important researches were made by Dr. W. Gilman Thompson, president of the board; Professor R. A. Harper, chairman of the scientific directors; Professor H. F. Osborn, president of the American Museum of Natural History; Provost William H. Carpenter, of Columbia University; Dr. Arthur Hollick, director of the Staten Island Institute of Arts and Sciences, and Professor Geo. T. Moore, director of the Missouri Botanical Garden, at St. Louis. At the conclusion of the ceremonies Mr. Robert DeForest presented Dr. Britton with a loving cup appropriately inscribed on behalf of the board of managers. Congratulatory letters and telegrams from distinguished scientific men were read.

Dr. Theodore W. Richards, professor of chemistry at Harvard University, has been elected president of the American Academy of Arts and Sciences.

Professor Paul P. Boyd, dean of the college of arts and sciences at the University of Kentucky, has been elected president of the Kentucky Academy of Science.

Rear Admiral John E. Pillsbury, U. S. N., has been elected president of the National Geographic Society.

The John Fritz Medal of the four national societies of civil mining, mechanical and electrical engineering has been awarded to Major General George W. Goethals, for his achievement in the building of the Panama Canal. The presentation was made on May 22 by Ambrose Swasey, past president of the American Society of Mechanical Engineers. The speakers included W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers; Henry L. Stimson, former secretary of war, and Colonel G. I. Fieberger, of West Point. Among those to whom the medal has been awarded in former years are: Lord Kelvin, for his work in cable telegraphy; Alexander Graham Bell, for the invention of the telephone; George Westinghouse, for the invention of the airbrake; Thomas A. Edison, for the invention of the duplex and quadruplex telegraph, and other devices, and Sir William H. White, for achievements in naval architecture.

Dr. C. G. Abbot, of the Astrophysical Observatory, Smithsonian Institution, sailed for South America on May 1, to inspect the Smithsonian solar constant observing station at Calama, Chile, and to observe the total solar eclipse at La Paz, Bolivia. He expects to return to Washington in August.

The following members of the Princeton University faculty have returned from service abroad: Lieutenant Colonel Augustus Trowbridge (Engineers), professor of physics; Captain E. P. Adams, Royal Engineers, British Expeditionary Force, professor of mathematical physics, and Captain H. L. Cook, also of the Royal Engineers, assistant professor of physics.

Arthur H. Blanchard, consulting highway engineer, has been appointed chief of the Bureau of Public Works, Department of Citizenship, under the Army Overseas Educational Commission.

Major George F. Sever, Engineers, U. S. A., has been honorably discharged from the United States Army after a service of fifteen months and will make his headquarters in New York City for consulting engineer practise. Major Sever during his service made extensive and detailed investigations of the electric power conditions in New England as well as on the Pacific coast from Seattle to Los Angeles. His investigations covered analyses of the production of power by coal, oil and water, and the comparisons of these different methods.

Second Lieutenant Asa C. Chandler, Sanitary Corps, formerly assistant professor of zoology at Oregon Agricultural College, has undertaken parasitological work at the Central Medical Department Laboratory of the A. E. F. at Dijon, France.

Professor J. M. Aldrich, formerly professor of zoology in the University of Idaho, has been appointed associate curator of the Division of Insects in the National Museum, but more recently has been working with the Bureau of Entomology.

Dr. Hermann von Ihering, formerly director of the Museum of the State of São Paulo, Brazil, has been appointed director of the State Museum of Sta. Catharina, Brazil, to be organized by him at Flerianopolis (Estado de Santa Catharina, Brazil).

At its meeting held May 14, 1919, the Rumford Committee of the American Academy of Arts and Sciences voted the following appropriations: To Professor P. W. Bridgman, of Harvard University, in aid of his research on the effect of temperature and pressure on the physical properties of materials, particularly their thermal conductivity (additional to previous appropriation), $400; to Professor Horace L. Howes, of the New Hampshire College, in aid of his research on the experimental study of the effect of temperature on the luminescence and selective radiation of the rare earths, $500.

A new acoustical laboratory has just been completed at Riverbank, Geneva, Illinois. This laboratory was built for the late Professor Wallace C. Sabine, of Harvard University, by his friend, Colonel George Fabyan. In this laboratory Professor Sabine proposed to carry on the study of a number of problems in architectural acoustics requiring special building construction and entire freedom from extraneous noises. The building was constructed with the most careful attention to details, according to Professor Sabine's plans, and has many interesting structural features. It was just ready for occupancy at the time of his death. Colonel Fabyan, the founder of the laboratory, proposes to carry out, as far as possible, the original purpose for which the building and its equipment were intended. Dr. Paul E. Sabine has resigned his position as assistant professor of physics in the Case School of Applied Science to take charge of the research program which had been laid out.

An entomological expedition to South America is planned by Professor J. Chester Bradley, '06, of the college of agriculture of Cornell University. Leaving Ithaca next September, Professor Bradley will visit Brazil, Argentina and Chile; in the following spring he will be joined in Peru by Professors Cyrus R. Crosby and Dr. W. T. M. Forbes, of the agricultural college, and the party will work on the Amazon River as far as Peral near the headwaters. The expedition is conducted under the auspices of the university for the two-fold purpose of securing entomological specimens and of forming closer relations with South American institutions of learning.

Dr. S. M. Zeller, who has been special investigator in timber pathology for the Southern Pine Association, of New Orleans, La., with laboratory at the Missouri Botanical Garden, St. Louis, has been appointed investigator in fruit diseases at the Oregon Agricultural College, Corvallis, Oregon.

After being at work for one year, the technical personnel of the Bacteriological Insti-

tute of Buenos Aires, has been reappointed in a recent decree reorganizing the institution. The sections and the individuals in charge are: hygiene, Dr. Carbonnell; plague, Dr. Uriarte; serotherapy, Dr. Sordelli; physics and chemistry, Dr. Wernicke; experimental physiology and pathology. Dr. Houssay; medical zoology, Dr. Bachmann, and parasitology, Dr. Wolffhugel.

PROFESSOR I. NEWTON KUGELMASS, head of the department of chemistry at Howard College, addressed the Southern Child Health Association on "Applied Nutrition for Raising the Standard of Child Vitality in the Service of the Newer National Domism," in Birmingham, on May 1.

AT the London meeting of the Institute of Metals on May 19, Professor F. Soddy, F.R.S., delivered the ninth annual May lecture on "Radio-Activity."

PROFESSOR J. H. JEANS, F.R.S., delivered a lecture on "The Quantum Theory and New Theories of Atomic Structure" at a meeting of the Chemical Society in London on May 1.

DR. AARON AARONSON, agricultural expert, of Haifa, Palestine, was killed in a fall of an airplane on May 15, near Boulogne, while flying from London to Paris. Dr. Aaronsohn had been a technical adviser of the United States Department of Agriculture.

THE next annual meeting of the American Chemical Society will be held in Philadelphia, from September 2 to 6, inclusive. The Philadelphia section is already planning to continue the rising curve of success and attendance for the meeting next fall.

SURGEON-GENERAL IRELAND has authorized during the present "emergency," the preparation and application of psychological tests to recruits, that men of low mentality may be barred from the army.

THE thirty-fifth anniversary of the establishment of the Bureau of Animal Industry of the Department of Agriculture occurred on May 9. When the bureau began operations in 1884 it had a staff of less than twenty employees; it has now more than 5,200, working through thirteen divisions and offices.

HOMER P. RITTER, for many years an officer of the United States Coast and Geodetic Survey and a member of the Mississippi River Commission, died at Washington, D. C., April 21, 1919. He was returning from a meeting of the Mississippi River Commission at Memphis and was taken ill on the train. On his arrival at Washington, on Saturday morning, he was taken to the Emergency Hospital, and died there. Mr. Ritter was born in Cleveland, Ohio, March 4, 1855. He attended the high school in Cleveland from 1869 to 1873 and Columbia College School of Mines from 1878 to 1880. He was afterwards employed for several years on railway surveys. He entered the Coast and Geodetic Survey in 1865; was appointed an assistant in 1895, and continued in the service until the time of his death. Mr. Ritter had been employed on field work in all parts of the United States and in Alaska and his last duty was in charge of the Field Station of the Coast and Geodetic Survey, at Boston, Massachusetts.

PROFESSOR JOEL STEBBINS, secretary of the American Astronomical Society, writes: "In SCIENCE for May 10 there is an announcement that representatives of certain foreign observatories will be at the meeting of the American Astronomical Society at Ann Arbor on September 1. This is a mistake because so far as known to the officers of the society there will be no such representation from abroad." The erroneous statement was taken from the *Michigan Alumnus.*

UNIVERSITY AND EDUCATIONAL NEWS

THE seismological library of Count F. de Montessus de Ballore, director of the Seismological Service of Chile, has recently been purchased by Dr. J. C. Branner and presented to Stanford University. This is probably one of the most complete collections of seismological literature in existence and it is accompanied by a manuscript catalogue containing nearly 5,000 titles.

THE department of medicine of the University of Toronto is to be the recipient of a gift

of $25,000 a year for a period of twenty-five years from Sir John and Lady Eaton. This is to provide for a full-time clinician in the department of medicine and a half-time clinician in pediatrics.

The court of governors of the University College of North Wales, at their meeting at Bangor, appointed a deputation to wait upon the Board of Agriculture regarding the proposal to have only two schools of forestry in Great Britain—one in Scotland and the other either at Oxford or Cambridge. Fears were expressed that if this was carried into effect it would mean the extinction of the forestry department in connection with the University College of North Wales. It was felt that one of the two new schools should be established in Wales, with its large area of forests.

Sir Arthur Newsholme, K.C.B., who is now in the United States has accepted for the academic year 1919–1920, the chair of hygiene in the new school of public health of the Johns Hopkins Medical School.

Charles Joseph Tilden, professor of civil engineering at Johns Hopkins University, has been elected professor of engineering mechanics in Yale University and assigned to the Sheffield Scientific School.

Austin F. Rogers and Cyrus F. Tolman, Jr., of the department of geology at Stanford University, have been promoted from associate professors to professors.

Morris M. Leighton, Ph.D., Chicago, 1916, has accepted a joint-position as assistant professor of geology at the University of Illinois and as Geologist on the Illinois Geological Survey.

At the Massachusetts Institute of Technology the following assistant professors have been promoted to associate professorships: H. C. Bradley, department of drawing and descriptive geometry; C. E. Locke, department of mining engineering and metallurgy, and N. C. Page, department of electrical engineering. The following instructors have been appointed assistant professors: J. B. Babcock, 3d, railroad engineering; S. A. Breed, mechanical drawing and descriptive geometry; L. A. Hamilton, analytical chemistry; H. B. Luther, civil engineering; C. S. Robinson, industrial chemistry; R. H. Smith, mechanical engineering; C. E. Turner, biology and public health.

Mr. William Morris Jones, M.Sc., B.A., has been appointed lecturer and experimentalist in physics at the University College, Bangor.

DISCUSSION AND CORRESPONDENCE

QUANTITATIVE CHARACTER-MEASUREMENTS IN COLOR CROSSES

The writer, although working in plant and not in animal breeding, has been struck with the desirability of finding a more exact quantitative measure of degree of distribution of coat color in animal crosses. The following is suggested. Photograph the animal in a centered position on its two flanks. On the photographic prints of the right and left sides, determine the area of the color markings under investigation with a planimeter. These areas, reduced to percentages of the entire area photographed, will give a quantitative expression for the degree of extension of the character markings. The writer would venture to suggest the following possibility in the study of the operation of an extension factor. Let the photographic prints be ruled off in square centimeter areas with India ink. Then the relation of the color areas to the region of the animal's anatomy can be definitely established upon a quantitative basis. This having been done for the parents, the operation of an extension factor could be studied both quantitatively with respect to the amount of surface over which the factor became operative, and topographically with respect to the location and range of its operation in the progeny. If desired, it would be a comparatively simple matter to construct a cross-wire screen behind which the animal could be photographed, and which would thus reproduce the areas to scale directly.

In the study of inheritance in plants, the application of this method suggests itself very readily in color-inheritance in the seed-coats of beans and other legumes. By photograph-

ing the seeds with a photomicrographic apparatus, enlarging them a sufficient number of times, it is easy to bring the markings within the range of size where the use of the planimeter becomes a practical matter.

H. F. Roberts

Kansas State Agricultural College,
April 28

SURPLUS BISON FOR MUSEUMS

There is now a great surplus of male bison in the main Canadian herd at Buffalo Park, Wainright, Alberta. This is the largest herd of bison in the world, numbering 3,561 and is maintained by the Canadian government under the administration of the Dominion Parks Branch of the Department of the Interior.

Besides these 3,561 bison, there are also 8 at the Rocky Mountains Park, Banff, Alberta, and 182 at Elk Island Park, Lamont, Alberta. In 1909, there was a total of 685 bison at Buffalo Park, 118 were imported during 1910, 1911 and 1912 from the Pablo herd in Montana, and 10 bison cows from the Rocky Mountains Park during the winter of 1913–14. With the exception of these the increase has been due to natural causes.

It is said that elsewhere the percentage of male to female calves has been higher among bison in semi-captivity within enclosed parks than was the case when the herds freely roamed the plains. This has proved to be the case in the main Canadian herd, so that there is a great surplus of male bison that are not needed for herd purposes.

It is proposed to dispose of these surplus male bison for the nominal sum of $250 each to bonafide natural history museums of Canada and the United States, and further information can be obtained by such museums from Mr. J. B. Harkin, Commissioner of Dominion Parks, Department of the Interior, Ottawa, Ontario, Canada.

This should prove a splendid opportunity not only to secure skins for mounted specimens and groups, but also for museums to send their preparators to Buffalo Park to secure photographs, color sketches and accessories for habitat groups, and to secure skeletons, anatomical preparations of internal organs and parasites.

Harlan I. Smith

Museum of the Geological Survey,
Ottawa, Canada

INFORMATION SERVICE FOR EXPERIMENTAL BIOLOGISTS

To the Editor of Science: The Federation of American Societies for Experimental Biology, comprising the sciences of physiology, biological chemistry, pharmacology and experimental pathology, is now organizing an information service to serve as a medium of communication between persons seeking positions for teaching or research and institutions that wish to fill vacancies in these sciences. Persons, whether members of the federation or not, and institutions desiring to avail themselves of the service may communicate with Professor Edgar D. Brown, secretary of the executive committee of the federation, University of Minnesota, Minneapolis, Minn., and such information as is available will be supplied without cost to the applicant. Applicants are requested to supply the service with ten copies of their application, which should cover the following points:

1. *For the Person seeking a Position:* age; college and university training; degrees received; academic or other positions held; list of scientific papers published; membership in scientific societies; position and salary desired; copies of letters of recommendation; names and addresses of persons who can supply further information regarding the applicant; and any other information that the applicant desires to submit.

2. *For the Institution desiring to fill a Vacancy:* title of vacant position; date to be filled; requirements as to teaching or other routine work and research; salary to be paid; prospects of tenure of office and advancement; and any other information that the institution desires to submit.

The service does not undertake to recommend or to pass judgment upon applicants. It aims merely to serve as a clearing-house for such information as the above and to

bring into touch with one another candidates for positions and vacancies to be filled.

E. D. Brown,
University of Minnesota, Secretary

SCIENTIFIC BOOKS

The Mineral Deposits of South America. By Benjamin L. Miller, professor of geology, Lehigh University, and Joseph T. Singewald, associate professor of economic geology, Johns Hopkins University. New York, McGraw-Hill Book Company, Inc. 1919. Pp. 598, with 61 figs.

South America is a continent richly endowed with mineral resources: In Brazil are the largest high-grade iron-ore deposits in the world; at Chuquicamata, Chile, is the largest copper deposit in the world and the copper resources of Chile are second only to those of the United States; the nitrates of Chile constitute a world monopoly of that commodity; the tin lodes of Bolivia are by far the most productive in the world, their annual output being seven fold that of their nearest competitor; the world's greatest vanadium deposits are in Peru; and the only considerable source of platinum outside of Russia is in Colombia. The mineral deposits are not only of great importance commercially but are also of deep interest scientifically; and, as the present book by Professors Miller and Singewald shows, not more than a beginning has been made in solving the geologic problems they present.

The book under review, as we are told in the preface, is "the outcome of an extended trip through South America made by the authors in 1915." It is essentially a digest of available information on the mineral deposits of that continent, supplemented, however, by data the authors obtained during the visits, necessarily hasty, that they made to many of the mineral deposits of Brazil, Chile and Peru.

The opening chapter of the volume gives an outline of the geography, general geology and mineral resources of South America. It sketches also the history of the growth of the mineral industry, discusses the relation of mining to other industries, and outlines the probable trend of the future development. In view of the ground covered, the chapter, comprising thirty-two pages, is somewhat scant. It could be improved also by the addition of a series of outline maps of the continent showing quantitatively where the more important mineral commodities are produced, and by the insertion of statistical tables and diagrams showing the relation of South America's mineral output to that of the rest of the world. Such aids in giving the reader generalized views of the continent as a whole are conspicuously few in the present volume, but their urgent desirability should be considered by the authors when a new edition is planned. In places throughout the book there is an unnecessarily abundant use of local Latin-American terms, for most of which the authors could easily have substituted perfectly good English equivalents.

The remaining eleven chapters take up in alphabetical order the countries of South America. The description of the mineral resources of each is introduced by a summary of production. In places some statistical errors have crept in, as on page 77, where the outputs of lead, zinc and tin of Bolivia are given in terms of metal, whereas the figures cited are in reality those of ore or concentrate. Nor is it mentioned that the unit employed is the metric ton. These oversights are pointed out in passing, because current international statistics of mineral output are commonly vitiated by similar lapses. The summary of mineral production is followed by sketches of the topographic and geologic features of the country, of the distribution of the mineral deposits, and of the occurrence of the chief mineral resources. This general treatment is followed by more detailed descriptions of the important deposits and districts. Each chapter closes with a selected bibliography, the number of entries ranging up to 225 titles for the chapter on Chile. The entries are generally accompanied by brief synoptic characterizations. It is not always indicated that some Latin-American entries are merely translations of papers that appeared originally in French, German, American or other publications.

One of the notable sections of the volume

is the account of the Bolivian tin veins. Professors Miller and Singewald were fortunate in finding fossil plants in the shales at Potosi, and as a result of this discovery were able to establish that the tin veins at Potosi were formed in Pliocene or Pleistocene time. This is a remarkable conclusion and shows that these wonderfully productive tin lodes are in a geological sense extremely youthful; in fact they are probably the most youthful economically valuable mineral deposits of first rank in the world. Professors Miller and Singewald extend this age determination to all the Bolivian tin veins and maintain that they are all of Pliocene age. This conclusion may or may not be true, for the veins of the different districts appear to be associated with igneous rocks of a wide range of texture: pegmatites, aplites, granite, granite porphyry, rhyolite porphyry, rhyolite and "true quartz porphyry." As a matter of fact, no thorough field study of the Bolivian tin veins as a whole has yet been made. The studies hitherto made have been mainly petrographic, by geologists who have not collected the specimens they studied. It is not to be expected that a very deep insight into the fundamental problems could be attained by that method. Even in such a relatively subordinate matter as the nomenclature of the igneous rocks the petrologist has felt it necessary to use such obsolescent, non-committal terms as quartz porphyry to describe some of the rocks to which certain Bolivian tin veins are genetically related. When field work becomes the main method of attack and the microscope is used as an auxiliary—a powerful auxiliary it is true—more satisfactory results will be attained, and it is therefore a pleasure to learn that Professor Singewald is returning to Bolivia in order to take up a careful study of the tin veins in their broader geologic aspects.

Another district of special interest is Corocoro in Bolivia, which like the Lake Superior district is one of the world's two productive copper districts in which the chief ore mineral is native copper. Brazil holds the distinction of having in the Morro Velho mine the deepest mine in the world, the lowest workings having attained a vertical depth of 6,128 feet. The ore on the lower levels averages nearly $13 a ton in gold and indicates an extraordinarily long vertical range of gold-ore deposition. Apparently not much is known about the geology of this remarkable ore body, however. There are many other interesting deposits described in the book, but it would lengthen this review unduly even briefly to call individual attention to them. The outstanding feature of the economic geology of the South American continent is its preeminence in the number of its geologically youthful primary ore deposits of the first order of magnitude.

Professors Miller and Singewald have placed all interested in the mineral resources of South America under a deep debt for the labor they have expended in marshalling the widely scattered information and for presenting it attractively in a condensed and easily usable form. They can be gratefully assured that they have filled a genuine want in the literature of economic geology.

ADOLPH KNOPF

UNITED STATES GEOLOGICAL SURVEY

THE ECOLOGY OF NORTH AMERICAN LYMNÆIDÆ

IN a recent paper in SCIENCE[1] the following statement appears: "There are three groups of limnæas found in North America, the abysmal limnæas including *Lymnæa* (*Acella*) *haldemani* Binney, the moss limnæas including *Lymnæa* (*Galba*) *truncatula* Müll., *humilis* Say, and the marsh limnæas including *Lymnæa stagnalis, L. columella,*" etc. This classification of our pond snails is so unusual and so far from representing the true ecological relations of this group, as well as of the allied groups *Planorbis* and *Physa*, that a few observations on the subject seem necessary.

As far as known there are no abysmal lymnæas or other fresh-water pulmonates in America, comparable to the true abysmal fauna of the deep lakes in Switzerland, where *Lymnæa stagnalis* occurs in Lake Geneva at a depth of 250 meters and *Lymnæa abyssicola*

[1] SCIENCE, N. S., XLVIII., p. 578, 1918.

in Lac Leman at depths of 25 to 250 meters.[2] In the Swedish lake Vätter, mollusks, including lymnæas have been dredged from depths down to 120 meters.[3] In America no such depths have yielded mollusks in our fresh-water lakes, the deepest water from which lymnæas have been found being in Lake Michigan where several species were obtained at High Island Harbor at a depth of 10 meters.[4] It is possible that some of the deep western lakes, as Lake Pend d'Orielle, Idaho, examined by the writer some time ago, may contain a deep-water fauna.

The species cited as an example of abysmal lymnæas, *Acella haldemani* (Desh.) Binney, is really a shallow-water, swamp-loving species, when adult, in the fall, living at or near the surface attached to vegetation in water less than five feet deep. In summer (July) the young may be found in water not exceeding six feet deep, among such plants as *Potamogeton*.[5]

The present center of distribution of American lymnæas is the Canadian faunal region, where upwards of 50 species and races live. North and south and east and west of this area there is a more or less rapid decrease in number of species. It is in this area that we find the greatest variation in the ecological relations of the group. This is due in part to the effect on the topography made by the great ice sheet which swept over the territory during the Pleistocene Period, and left upon its retreat the largest number of ponds and small lakes known in any part of the world. As typical pond and lake animals, the lymnæas have reacted favorably to this profusion of small bodies of water and a large and varied fauna has resulted. This is also true of other groups of fresh-water mollusks especially the related fresh-water pulmonates, *Planorbis* and *Physa*.[6] Ecologically, our lymnæid fauna may be divided into about five types:

1. *The open shore lake type,* where the environment is an open shore of a lake exposed to the full force of the winds and waves. Here such lymnæas as *Lymnæa stagnalis lillianæ* Baker, *Galba catascopium* Say, *G. emarginata* Say, and *G. nasoni* Baker are common and typical of such a habitat.

2. *The quiet bay or pond type,* where the environment is protected from the force of the waves and wind by barriers of one kind or another. The water is shallow and there is usually an abundance of vegetation, such as *Scirpus, Potamogeton, Castalia, Nymphæa, Typha* and filamentous algæ which provide much of the food of these snails. Such species as *Acella haldemani* (Desh.) Binn., *Pseudosuccinea columella* (Say), *Bulimnea megasoma* (Say), and *Lymnæa stagnalis* Linné are typical of such a habitat.

3. *The marsh type,* where the water is shallow, seldom more than three or four feet deep, and where there is an abundance of swamp vegetation such as *Typha, Pontederia, Decodon* and a few *Nymphæa*. The bottom is usually of mud or accumulated vegetable débris. Such species as *Galba palustris* (Müll.), *G. obrussa* (Say), *G. reflexa* (Say), and *G. elodes* (Say) are characteristic of this kind of a habitat.

4. *The mud-flat type.* This type of habitat may border a swamp, pond or river, where the water is quiet and where an area of wet mud is left just above the water line. Here small species of the subgenus *Simpsonia* are at home and we find such species as *Galba parva* (Lea), *G. dalli* (Baker), *G. umbilicata* (Adams), and some of the small varieties of *G. obrussa* (Say) living by thousands, simulating the marine Littorinas in their ecological relations.

5. *The intermittent pool or stream.* This is a type of habitat found in all parts of the

[2] Forel, *Bull. Soc. Vaudoise des Sci. Nat.*, X., p. 217; XIII., p. 1 (1869, 1874).

[3] *Internationale Revue der gesamten Hydrobiologie und Hydrographie,* Band 7, Heft 2–3, pp. 146–204, 1915.

[4] Walker, *Nautilus,* IX., pp. 3–5, 1895.

[5] For the life history and ecology of this species see Baker, *Nautilus,* XXX., pp. 135–138; Tech. Pub. No. 9, N. Y. State College of Forestry at Syracuse University, 1918.

[6] Baker, "Monograph Lymn. N. A.," pp. 52–67, 1911.

United States, but especially common in the west and southwest, in the more arid parts of the country, where water stands for but a small part of the year and where the lymnæas, and other mollusks must be able to withstand the period of drouth by hibernating in cracks in the bottom of the pond or stream. Such species as *Galba caperata* (Say), *G. cubensis* (Pfr.), and *G. bulimoides* and its varieties are typical of these habitats. *Galba palustris* and some other species normally living in marshes may at times be compelled to adopt this hibernating type of habitat during unusual periods of drought.

The writer has not found lymnæas as a rule inhabiting moss, although the little amphibious species (*parva, dalli,* etc.) may do so in some places and have, indeed, been collected from such a habitat. All lymnæas as well as other fresh water mollusks, whether in lake or marsh habitats, prefer a location where there is a quantity of vegetation and where there is an abundance of filamentous algæ (*Cladophora, Œdogonium,* etc.) upon which they largely feed, in some cases to such an extent as to give a green color to the shell. The relation of algæ to molluscan and other life has recently been rather fully stated by the writer.[7]

It is interesting to note that fresh-water mollusks, the lymnæas in particular, respond quickly to changes in environment, a species characteristic of a marsh adapting itself to a rough lake shore habitat if compelled to make the change. Thus typical *stagnalis* is characteristic of quiet, pond-like bodies of water, while the variety *lillianæ* lives on a shore exposed to the full force of the waves. The change in habitat has resulted in a larger aperture and foot in *lillianæ* the better to resist the moving power of the waves. In Oneida Lake, a large colony of *Galba palustris* was forced by a change in the environment, caused by the barge canal construction, to change from a shallow swampy habitat to that of an open rocky shore exposed to violent wave action. The effect of this change has been to produce a shell with a wide, flaring aperture and a larger foot area, a direct response to the environment which demands a larger foot area for resisting the waves.[8] The lymnæas are not, as generally supposed, mollusks chiefly of ponds and ditches, as might be thought from reading the paper in SCIENCE, but also of the larger inland lakes, in fact a greater variety is found in the lakes than in any other kind of habitat.

The fossil lymnæas, as well as other fresh-water fossil groups, are in need of careful revision in the light of modern work on the existing species. As the shell in a measure reflects the internal structure, this revision ought not to be difficult with ample material of fairly well-preserved specimens. The twenty-five or more species described appear to represent the larger groups recognized among the recent forms. Several of these species, as mentioned by Hannibal, are problematic and may belong to other groups, but more perfect material is needed for this purpose. Some confusion of species has occurred in figuring and describing a few of these lymnæas, attention to which has already been directed by the writer.[9]

FRANK COLLINS BAKER
UNIVERSITY OF ILLINOIS

SPECIAL ARTICLES

SOUND AND FLASH RANGING[1]

THE location, by means of sound, of active enemy batteries and the direction of the fire of the friendly artillery on these and other enemy objectives is new; has been successfully practised by the Allies and has been clumsily practised by the Germans. The location and ranging by visual observation (flash ranging) is an outgrowth of standard artillery methods and differs from these chiefly in the extent of front covered by a single group of observers and by the adoption of certain electrical devices and

[7] Tech. Pub., No. 9, N. Y. State College of Forestry, Syracuse University, 1918.

[8] Baker, Tech. Pub. No. 9, N. Y. State College of Forestry, p. 180.

[9] "Mon. Lymn. N. Am.," pp. 89, 95, 96.

[1] Abstract of paper presented before the American Philosophical Society, April 26, 1919.

methods of observation designed to avoid confusion in operation on a very active front. The Germans had an extremely efficient flash ranging service, many of the good features of which were copied by the Allies as they became known through captured documents. The flash ranging reported not only the positions and activity of hostile batteries, but also the exact locations of other enemy objectives such as traffic on roads, troop movements, position of observation balloons, etc. Being provided with high-power telescopes, and since observation was obtained from stations on a wide base (from five to eight miles) the flash ranging sections were particularly well suited for observation and ranging in the enemy back areas, and these sections rendered invaluable services both to the artillery and to the army intelligence.

A battalion of five companies (74th Engineers) furnished the ranging troops for an American army. A sound ranging section was in the field with the first American division to enter the line (March, 1918) and on the signing of the armistice the entire front of the second American army was covered with both flash and sound ranging sections and a portion of that of the first American army was covered by flash ranging, although the ranging battalion allotted to this army had not yet arrived in France. The ranging service was thus a "going concern" from the very first and was not one of the many which could have delivered results had the war but lasted a little longer.

A flash ranging section consisted of about one hundred men commanded by a lieutenant who was assisted by three other officers and by an exceptionally high grade of non-commissioned officers and men, all of whom had been given a month's intensive training in France. The instruments and methods employed were those suited for accurate survey and present no special features of interest.

A sound ranging section was similar in organization to the flash section except that there were fewer enlisted men (60–70) due to the fact that instruments took the place of living observers to a great extent. The "central" instrument recorded photographically the time of arrival of the sound of the enemy guns at a series of instruments at surveyed positions near the front line and covering a length of about five miles; this instrument delivered automatically developed and fixed photographic records in less than a minute after the sound of the enemy gun reached the front line and this record could be interpreted by the use of quick graphical methods so that the position of the enemy gun could be telephoned to the friendly artillery in about a minute more. The probable accuracy of the location could be given and also the caliber and target of the piece which had just fired. The service was not interfered with by rain or fog or darkness, though it was rendered less accurate by strong winds. Calculations were rendered difficult by great artillery activity though not impossible except under actual "barrage" conditions.

In ranging the friendly artillery on enemy objectives it was possible to range all the guns of the battery simultaneously, thus effecting considerable time saving over other methods of ranging. If the ranging was being done on an enemy battery which had just fired the accuracy attained was very great (less than twenty-five yards), because of the fact that in this case no wind or temperature corrections need be applied in the calculations.

After the American advances of September and November a careful survey was made of most of the enemy positions which had been located by either the sound or the flash ranging sections on a part of the American front; the result of this survey was that of the locations of the flash ranging about one third were accurate to within fifty yards, another third to within one hundred yards and the other third with errors of more than one hundred yards. In the first third were many extremely accurate locations of guns the positions of which were visible from two or more observation posts; in the last third were mostly locations of concealed heavy caliber distant guns generally more easily located by sound ranging, whose positions could only be inferred from smoke puffs by day or flares in the sky by night.

The survey showed that the estimates of accuracy made by the sound rangers in report-

ing a location had been very conservative; a location reported not accurate to within fifty yards was often accurate to within twenty-five yards. In general, the average of a half dozen locations of the same gun taken on different days under differing weather conditions was of a very high order of accuracy; often a matter of but five or ten yards.

In general a location either by sound or by flash which had been rated "fair" when reported to the artillery was found on survey to have been within the unavoidable errors in artillery fire.

An idea may be gained of the amount of artillery information supplied by the ranging sections from the following figures taken from the reports of the artillery information officer of one of the American corps. This officer had at the time the following sources of information: three American sound ranging sections, two American and three French flash ranging sections, aviation and observation balloons. During a period of three weeks of rapid advance when the sound sections were out of operation while moving for a considerable portion of the time 425 separate locations of enemy batteries were made. Of these the two American flash sections reported 64 per cent. the three French flash sections reported 16 per cent. and the three American sound sections reported 21 per cent. In a period of two weeks when the advance had been checked by the Germans the total number of locations were 392, and the percentages were: From the three American flash sections 38 per cent.; from the two French flash sections 8 per cent., and from the three American sound sections 56 per cent.

The following figures taken from another and very active sector are also instructive. For a period of three days preparation for an advance the following locations were made: Sound, 22; flash, 22; balloons, 0; aviation, 0. For a period of sixteen days of rapid advance: Sound, 4; flash, 46; balloons, 30; aviation 77. For a period of four days of stabilization: Sound, 6; flash, 34; balloons, 13; aviation, 15. These figures are characteristic. During preparations for an advance, both the sound and flash sections are very useful and important sources of information. During rapid advance the sound ranging does not get into action as often or as soon as the flash. In this period the greater part of the information comes from the air observation.

Both sound and flash ranging have proved their value in the American Expeditionary Forces and are to be retained in the peacetime army; the sound because it is the one source of information when all others fail in foggy weather and because thus far no camouflage has been devised to prevent its working; the flash because of its relatively great mobility and consequent importance in open warfare.

AUGUSTUS TROWBRIDGE
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THE AMERICAN MATHEMATICAL SOCIETY

THE two hundred and third regular meeting of the society was held at Columbia University on Saturday, April 26, extending through the usual morning and afternoon sessions. This being the first eastern meeting since October, the attendance was large, including sixty-seven members, indicating, as it may be hoped, a revival of the conditions preceding the war.

President Morley occupied the chair, being relieved by Professor Kasner. The election of the following persons to membership in the society was announced: Mr. N. W. Akimoff, Philadelphia, Pa.; Dr. Tobias Dantzig, Columbia University; Mr. A. C. Maddox, Guthrie, Okla., High School; Mr. Montford Morrison, Chicago, Ill.; Professor Ganesh Prasad, Central Hindu College, Benares, India; Mr. F. M. Weida, State University of Iowa; Mr. C. L. E. Wolfe, University of California. Two applications for membership were received.

It was decided to hold the coming summer meeting of the society at the University of Michigan in the first week in September. Professors Beman, Bliss, Karpinski, Osgood and the secretary were appointed a committee on arrangements for this meeting. A committee was also provided to prepare nominations for officers to be elected at the annual meeting in December.

Professor E. W. Brown, L. E. Dickson and H. S. White were appointed as representatives of the society in the division of physical sciences of the national research council; and President R. S.

Woodward, and Professors Birkhoff and MacMillan as representatives of the society in the American section of the International Astronomical Union.

The committee on the publication of a mathematical year book presented a preliminary report and was continued and asked to make a further report at a future meeting.

A special feature of the meeting was the reports by Captain Jackson, Dr. Gronwall and Major Veblen on the work in ballistics at Aberdeen and Washington, which occupied the first part of the afternoon session. The titles of these reports are included in the list of papers below.

About fifty members and friends gathered at the midday luncheon; thirty-two attended the dinner at the Faculty Club in the evening. Much satisfaction was expressed at the revival of these pleasant occasions.

The Chicago Section held its regular spring meeting on March 28–29. The San Francisco Section met at the University of California on April 5.

The following papers were read at the New York meeting:

C. J. Keyser: "Concerning groups of dyadic relations in an arbitrary field."

J. K. Whittemore: "Certain functional equations connected with minimal surfaces."

W. B. Fite: "Linear functional differential equations."

L. B. Robinson: "Note on a theorem due to Wilczynski."

L. B. Robinson: "A curious system of polynomials, continued."

O. E. Glenn: "Covariants of binary modular groups."

O. E. Glenn: "Modular covariant theory of the binary quartic. Tables" (preliminary report).

O. E. Glenn: "Invariants of velocity and acceleration."

F. H. Safford: "Reduction of the elliptic element to the Weierstrass form."

Philip Franklin: "Computation of the complex roots of the function $P(z)$."

A. R. Schweitzer: "On the history of functional equations" (preliminary report).

E. D. Roe, Jr.: "The irreducible factors of $1 + x + \cdots + x^{n-1}$. Second paper."

E. D. Roe, Jr.: "The irreducible factors of a circulant."

Dunham Jackson: "Small arc computations and related questions."

T. H. Gronwall: "Qualitative properties of the ballistic trajectory."

Oswald Veblen: "Progress in design of artillery projectiles."

G. D. Birkhoff: "Boundary value and expansion problem for differential systems of the first order."

G. D. Birkhoff: "Note on the closed curves described by a particle moving on a surface in a gravitational field."

G. D. Birkhoff: "Note on the problem of three bodies."

Edward Kasner: "A characteristic property of central forces."

J. F. Ritt: "On weighting factor curves for low elevations."

A. C. Lunn: "Some functional equations in the theory of relativity."

J. R. Kline: "Concerning sense on closed curves in non-metrical plane analysis situs."

R. L. Moore: "On the most general class L of Fréchet in which the Heine-Borel-Lebesgue theorem holds true."

H. S. Vandiver: "On the class number of the field $\Omega(e^{2i\pi/p^n})$ and the second case of Fermat's last theorem."

F. W. Beal: "On certain points of congruences of circles."

L. L. Silverman: "Regular transformations of divergent series and integrals."

T. C. Fry: "The application of the modern theories of integration to the solution of differential equations."

C. A. Fischer: "Completely continuous transformations and Stieltjes integral equations."

Arnold Emch: "On closed curves described by a spherical pendulum."

H. S. White: "An explicit formula for two old problems."

L. P. Eisenhart: "Triply conjugate systems with equal point invariants."

F. N. COLE,
Secretary

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SIR JOSEPH HOOKER[1]

With the passage of time the importance attached to persons and events becomes strangely altered. History, to be of value to posterity, must be both more and less than a faithful chronicle of the past. Less, if only to bring it within intelligible limits; more, because it must see causes in relation to effects, emphasizing the inconspicuous beginnings of new developments. For such reasons, the judgment of posterity will nearly always differ from that of contemporaries; not necessarily because posterity is endowed with superior wisdom, but rather because the basis of judgment is different. Sir Joseph Hooker and his father, Sir William Hooker (1785–1865), were both botanists of the highest eminence, their combined activities covering more than a century. As we review their careers, we do not know which to admire most. The son, without the slightest false modesty, always insisted on his father's preeminence, giving good reasons for his judgment. It was William Hooker who, with extraordinary energy and enthusiasm, had created great botanical centers, first at Glasgow, and then for the whole British Empire at Kew. When the work was most difficult and recognition hardest to obtain, he had won support and respect; and had laid the foundations on which his son was to build. It is difficult for us, to-day, to realize the labor and vision required to build up the establishment at Kew, in the face of ignorance and opposition. It is difficult for posterity to do full justice to the elder Hooker, just because we can no longer clearly visualize the environment in which he lived. His work, everywhere woven into the fabric of modern botany, has few outstanding or picturesque features. In the case of Sir Joseph Hooker, the imagina-

[1] *Life and Letters of Sir Joseph Dalton Hooker.* By LEONARD HUXLEY. 2 vols. New York, D. Appleton & Co. 1918.

tion is more easily quickened. Aside from his great merits as a master of technical botany, he will always live in the pages of history as one of the group of men immediately associated with Darwin. The personalities of Darwin, Hooker, Huxley and Wallace stand out in the history of biological science in such a manner that they are never likely to be forgotton. On the contrary, because they will be taken as typical of a movement and a period, they will increase rather than diminish in the estimation of mankind. They will have the value of a moral force; veritable saints of science, patterns for all later generations. In strict equity, it may be that Hooker should not stand on so high a pedestal as we shall place him, but we are concerned rather with our needs than his deserts.

Under these circumstances, an authoritative and full account of the life of Sir Joseph Hooker becomes a necessity. This work, written by Leonard Huxley, and based on materials collected and arranged by Lady Hooker, has just been published in two volumes, and is the subject of this notice. It is the story of a long life of incessant activity; devoted to the classification and description of plants, the administration of a great botanical establishment, and to explorations in distant regions. In 1837 Hooker published the descriptions of three new mosses; in 1911 he published a number of new species of *Impatiens*. Such a record is surely unique. It seems strange to think that this man, whose living presence is still vividly in our mind, knew four of the founders of the Linnean Society, and talked with Humboldt. There is an amusing account of his first meeting with Humboldt in Paris:

On putting up here I sent in my card with Mr. Brown's books to Baron Humboldt; he was not at home, but sent his flunkey (Scoticè Footman) to my bedroom at eight o'clock yesterday morning to say his master wished to see me at nine o'clock. Ten minutes after his Lord had grown impatient and sent to say he was all ready, so I went in and saw to my horror a *punchy little German,* instead of a Humboldt. There was no mistaking his head, however, which is exceedingly like all the portraits, though now powdered with white. I expected to see a fine fellow six feet without his boots, who would make as few steps to get up Chimborazo as thoughts to solve a problem. I can not now at all fancy his trotting along the Cordillera as I once supposed he would have *stalked.* However, he received me most kindly and made a great many enquiries about all at Kew and in England.

Later on, Hooker was able to emulate Humboldt in the exploration of mountains, but on the other side of the world—in the Himalayas. The story of his Indian work is well known, but is of perennial interest. He did much more than explore new regions and find new plants. India is indebted to him for much of her scientific development and material prosperity. When he went there, he found the government singularly apathetic as regards science. He went out with Lord Dalhousie, the governor-general, who took a fancy to him and treated him very kindly, but had no interest in botany. In a letter home he relates:

I find Lord Dalhousie an extremely agreeable and intelligent man in everything but natural history and science of which he has a lamentably low opinion, I fear. He is a perfect specimen of the miserable system of education pursued at Oxford, and as ignorant of the origin and working of our most common manufacturing products and arts as he is well informed on all matters of finance, policy, etc. I very carefully drop a little knowledge into him now and then; but I can not awaken an interest or any sympathy in my pursuits: he is much pleased at my being busy, and especially with my carrying on my meteorological register three times a day. Lady Dalhousie shares her husband's apathy, but is otherwise a kind hearted creature. In the desert I brought them the gum arabic *Acacia,* which I thought must interest the late president of the board of trade; but he chucked it out of the carriage window: and the rose of Jericho, with an interest about it of a totally different character, met no better fate.

On his return from India and indeed while he was still there, he contemplated a "Flora Indica," to contain descriptions of all known Indian plants. In a letter to his father he wrote:

It is easy to talk of a "Flora Indica," and Thomson and I do talk of it, to imbecility! But

suppose that we even adopted the size, quality of paper, brevity of description, etc., which characterized De Candolle's prodromus, and we should, even under these conditions, fill twelve such volumes, at least . . . about eighteen years' fair work would be needed.

He then asks, how is such an undertaking to be supported?—"neither our government nor the East India Company will give a sum in any way proportional to the work." But the idea was never given up, and in 1897, after an interval of about fifty years, Hooker saw the publication of the last volume of "The Flora of British India." This he regarded as only a beginning—a preliminary assembling of scattered materials—and during the last years of his life he incessantly urged Indian botanists to study the living plants, and revise every part of the "Flora.' His own work on the Balsaminaceæ, carried on after he was ninety years old, represented the beginning of such a revision.

To the last, Hooker retained his special interest in the people of India as well as its "Flora." Thus, in the year of the coronation of King Edward VII.:

As I was at the Waterloo Station yesterday, four Indian regiments filed past me—they sent the blood flying to my finger tips, such grand fellows, and such gentlemen, such proud yet pleasant faces, such an air of dignity and self-respect.

In the Himalayas, he did some geological work which later proved of more value than he had anticipated. But when he studied fossil plants, he did not consider that he was leaving his special botanical field. "I am no geologist: my work is fossil botany; as legitimately a branch of *Botany* as is muscology; fossil plants, though imperfect, are still *pure* plants; and, though dead as species, they form and show links between existing forms, upon which they throw a marvellous light." Later on, he came to be very skeptical about the value of much of the work of the paleobotanists, and in 1887 expressed himself thus:

It is an ugly fact that, tempting as is the study of fossil botany, every competent botanist with a large knowledge of existing floras, and that has tried his hand on it, has given it up, notably Brown, Brongniart and Lindley, or these have subsequently confined themselves to specimens exhibiting *structure*, as fossil wood, etc.—whilst Oliver, Bentham, etc., have only shaken their heads when asked to identify a fossil plant. If you are ever at the Herbarium and will look at the multitudes of figures of leaves in Gardner, Lesquereux and other works, the vagueness of the identifications will strike you at once. There is a standing joke at the Herbarium [Kew], if you have a plant the affinities of which puzzle you, "fossilize it and send it to a paleontologist and he will give you the genus and species at once."

As materials accumulated at Kew, and Hooker found before him long series of specimens from numerous localities, he recognized many intermediates between supposedly distinct species. Thus he was led to make great allowances for variation, becoming what is sometimes called a "lumper." Darwin called his attention to the probability that many of the observed intermediates might actually be hybrids, and in a characteristic letter he replied:

The dismal fact that you quote of hybrid transitions between *Verbascum thapsus* and *nigrum* (or whichever two it was) and its bearing on my practise of lumping species through intermediate specimens, is a very horrible one; and would open my eyes to my own blindness if nothing else could. I have long been prepared for such a case, though I once wrote much against its probability. I feel tolerably sure I must have encountered many such, but have not had the tact to discern them, when under my nose, and hence I feel as if all my vast experience in the field has been thrown away.

It seems almost unbelievable to-day, that after Hooker's splendid work on the Antarctic floras and Indian explorations, he should have been so hard put to find a means of living by botany, that he was advised to abandon the subject. He was told that there was a vacancy in the mineralogical department at the British Museum, and,

To be sure I know nothing of crystallography, mineralogy, chemistry, etc., but the trustees are above such prejudice against a man who could wear a white neckcloth with ease, and take his fair share of their abuses with equanimity, which would be an all-powerful testimonial. I hate the idea

of giving up botany, but I am advised to try for it by Gray particularly and my father proposes it.

A few years later (1854) he said:

I sometimes think seriously of giving up Kew and living in London and writing for the press.

But it could not be, and when his friend Bentham had similar doubts, he wrote:

If I thought you would be a happier man I would advise you to give up botany; but you would not be so, and evil as our days are, whether they mended or worsed, it would be all the worse to you to have given up what is at least a wholesome and constant mental resource. I sometimes despond too, but as I was once told, "I am limed to the twig." and so are you!

The names of Bentham and Hooker, authors of the "Genera Plantarum," will always remain united in scientific literature. The personal association of the two men was all that could be desired; a result of their common interests and high character. Hooker writing to the botanist Harvey in 1856, takes occasion to say:

Bentham's unselfish love of science always charms me, he has never a thought of personal aggrandizement in money or honor; but indeed we have both of us lived under the highest examples and happiest influences in these respects. My father, Bentham and Thomson are such a trio as we shall never see again. Except Faraday and Darwin I know of no others in the walks of science so pure and disinterested, except perhaps Asa Gray in America.

In 1860 Hooker settled down to the work on "Genera Plantarum," and wrote to Huxley:

We are not likely to meet except at the Linnean, for I have inaugurated a new era in my life, and am going to take the world and all that is therein as coolly as I can. When perfect myself I shall commence operating on you. What is the use of tearing your life to pieces before you are fifty? which you are (and I was) doing as fast as possible.

Huxley's reply is so good, and so pertinent just now, that it must be cited at length:

And finally as to your resolutions, my holy pilgrim, they will be kept about as long as the resolutions of anchorites who are thrown into the busy world. Or, I won't say that, for assuredly you will take the work "as coolly as you can"—and so shall I. But that coolness amounts to the red heat of properly constructed mortals.

It is no use having any false modesty about the matter. You and I, if we last ten years longer—and you by a long while first—will be the representatives of our respective lines in the country. In that capacity we shall have certain duties to perform, to ourselves, to the outside world, and to science. We shall have to swallow praise, which is no great pleasure, and to stand multitudinous bastings and irritations, which will involve a good deal of unquestionable pain. Don't flatter yourself that there is any moral chloroform by which either you or I can render ourselves insensible or acquire the habit of doing things coolly.

It is assuredly of no great use to tear one's life to pieces before one is fifty. But the alternative for men constituted on the high pressure tubular boiler principle like ourselves, is to lie still and let the devil have his own way. And I will be torn to pieces before I am forty sooner than see that.

Hooker's correspondence with Harvey brings out some of his general ideas in an interesting way. He observes how the habit of precision grows until it becomes in a sense detrimental to progress:

The besetting sin of the botanists of the day is the *craving for perfect materials;* forgetful that these sciences are all progressive, and our efforts but steps in the progression. . . . I would urge you to think now of putting together some of your ideas and facts on wider branches than purely descriptive. I think that this becomes a duty after a certain time of life with those who keep such subjects before them—too much of our dear bought experience dies with us, and the pursuit of careful descriptive botany rather renders us too timid about striking out into generalities that are the product of years of insensibly gained ideas.

It is unnecessary to recount here Hooker's part in relation to the publication of Darwin's theory, or in connection with the spread of evolutionary ideas, but there is a little bit of personal history which is as interesting as it is amusing. We have all heard of the famous debate on evolution at the meeting of the British Association, when the Bishop of Oxford and Huxley crossed swords before an excited audience. It has not been generally understood that Hooker had a conspicuous

part in this affair, and his own account of it, written at the time in a letter to Darwin, is as follows:

Well, Sam Oxon got up and spouted for half an hour with inimitable spirit, ugliness and emptiness and unfairness. I saw he was coached up by Owen and knew nothing, and he said not a syllable but what was in the Reviews; he ridiculed you badly and Huxley savagely. Huxley answered admirably and turned the tables, but he could not throw his voice over so large an assembly, nor command the audience; and he did not allude to *Sam's* weak points nor put the matter in a form or way that carried the audience. The battle waxed hot, Lady Brewster fainted, the excitement increased as others spoke; my blood boiled, I felt myself a dastard; now I saw my advantage; I swore to myself that I would smite that Amalekite, Sam, hip and thigh if my heart jumped out of my mouth, and I handed my name up to the president (Henslow) as ready to throw down the gauntlet.

I must tell you that Henslow as president would have none speak but those who had arguments to use, and four persons had been bunked by the audience and president for mere declamation: it moreover became necessary for each speaker to mount the platform, and so there I was cocked up with Sam at my right elbow, and there and then I smashed him amid rounds of applause. I hit him in the wind at the first shot in ten words taken from his own ugly mouth; and then proceeded to demonstrate in as few more: (1) that he could never have read your book, and (2) that he was absolutely ignorant of the rudiments of Botanical Science. I said a few more on the subject of my own experience and conversion, and wound up with a very few observations on the relative positions of the old and new hypotheses, and with some words of caution to the audience. Sam was shut up—had not one word to say in reply, and the meeting *was dissolved forthwith*, leaving you master of the field after four hours' battle. Huxley, who had borne all the previous brunt of the battle, and who never before (thank God) praised me to my face, told me it was splendid, and that he did not know before what stuff I was made of. I have been congratulated and thanked by the blackest coats and whitest stocks in Oxford.

Henslow, best remembered as the teacher and friend of Darwin at Cambridge, was Hooker's father-in-law. The latter's respect and affection for him were unbounded. He writes to Huxley from Henslow's deathbed:

I am utterly overwhelmed; to be loved as he was for the good he had done I would lay down my science and almost turn parson. To me personally the loss will be inmeasurable—he took interest in everything I did and I loved him—I am wrong to think how much. His loss to this neighborhood will be incalculable; there is none to take his place morally, socially or religiously.

Hooker's attitude toward Darwin was that of a disciple. Although Darwin always looked up to Hooker as his master and guide in all matters botanical, the latter could unaffectedly write in this delightful strain:

The whole thing [*i. e.*, Hooker's masterly work on Welwitschia] is, however, a dry record of singular structures, and sinks down to the level of the dullest descriptive account of dead matter beside your jolly dancing facts anent orchid-life and bee-life. I have looked at an Orchid or two since reading the Orchid book, and feel that I never could have made out one of your points, even had I limitless leisure, zeal and material. I am a dull dog, a very dull dog. I may content myself with the *per contra* reflection that you could not (be dull enough to) write a "Genera Plantarum," which is just about what I am best fitted for. I feel I have a call that way and you the other.

In his early days, Hooker took an interest in entomology; and he recurs more than once to the relationship between insects and plants as having an important bearing on the larger problems of botany. Since he had no time for entomology, it is regrettable that he did not have a group of entomological friends to work on the problems he so often had in mind. The bees of high altitudes in the Himalayas, noticed by Hooker, were first studied and described from the collections of the Thibet Mission, fifty-five years later. Darwin's orchid book suggested to him:

That insects may have a wonderful deal more to do with checking migration than climate or geographics, and that the absence of whole genera may thus one day be accounted for by absence of genera of insects: in short the cat and clover story is capable of immediate expansion by any one having sufficient knowledge of plants, insects and geography.

Also, as regards the past:

I quite believe in the sudden development of the mass of phanerogams being due to the introduction of flower-feeding insects.

While fully alive to the importance of laboratory researches, Hooker felt that nothing could take the place of a knowledge of the various kinds of plants in nature; and that after all, the whole was, in a sense, greater than its parts. In 1886 he writes to Asa Gray:

I am more and more absorbed in Indian botany, and have thrown aside all idea of making headway with—any desire to keep up with even—heads of chemico-botany, and microphytology. I may content myself with a casual grin at young men calling themselves botanists, who know nothing of plants, but the "innards" of a score or so. The pendulum will swing round, or rather back, one day.

In 1894 he recurs to the same subject, and writes to Francis Darwin:

I am glad you are going to teach the medicos a little practical botany. It is lamentable to find that all this botanical teaching of the greatest universities in England and Scotland does not turn out a single man who can turn his botanical knowledge to any use whatever to his fellow creatures. Where should we be if medicine, law or any other pursuit were taught after that fashion?

In his general ideas of education, he was "modern" in the sense of desiring practical vocational training; and in his indignation against the claims of the classicists. But he seems to have had little or no vision of an educated democracy, nor indeed of democracy in any form. He greatly admired certain characteristics of the Americans, writing to Asa Gray as early as 1854:

When you Yankees take up the higher branches of botany more generally you will turn out far more and better work than we do, for you are a far better educated, sounder, more practical people, and I look to you for the greatest discoveries, come when they may.

And in 1877, after traveling across the United States with Asa Gray, he wrote:

I had not the ghost of an adventure in America, where I saw a prodigious deal and learnt much. California was burnt up with nine months' drought, which obliterated the herbaceous vegetation and allowed me full time for the arboreous and fruticose. I was charmed with New England, disappointed with the Rocky Mountains as a range, and have no love for California, but all are full of great interest, and wonderful resources. Niagara did not disappoint me nor did the big trees. . . . The people I found to be wonderfully nice, and A. Gray is a trump in all senses.

The following, to W. E. Darwin in 1893, is singularly pertinent to-day:

I am dreamer enough to look for a time when America will forbid a European war! What a splendid rôle this would be for a nation to undertake—to send us all to our tents and tell us that we may snarl at one another in the length and breadth of Europe as much as we please, but nothing more, and that if we go further she will intervene.

Here we may leave this fascinating record of opinions and events, having quoted freely, but scarcely more than touched the treasures it contains. To have read it, following Hooker to the Antarctic, the Himalayas, the Atlas mountains and America; visiting him through it at Kew and at his home; all this is sufficient to stir the imagination and ambition of the most lethargic if he cares anything for science. The book should be in all public libraries; and it is permissible to hope that eventually a cheaper edition, perhaps somewhat abbreviated, may further widen the circle of its influence.

T. D. A. Cockerell
University of Colorado

A SUGGESTION FROM PLATO, WITH OTHERS

Students of human embryology, obstetricians and gynecologists are in daily need of terms to designate the various things included in an abortion. Many also realize the need for a more consistent use of such old words as embryonic and ovum. The word ovum constantly is used in contemporary medical literature to designate the unfertilized female sex cell; this cell when fertilized, the chorionic and amnionic vesicles with or without the contained embryo, and even the later product of conception. Under such circumstances confu-

sion is unavoidable and it certainly would seem advisable to restrict the term ovum to its comparative embryological significance. But this restriction leaves us without a designation for the whole product of conception. For this the word conceptus fortunately seems to be available. It is not new, and does not sound particularly well in the plural but we have other similar words in long established usage to which the latter objection applies. The term conceptus has the advantage of being applicable throughout the entire period of gestation.

It may seem that we should make use of the word conception, but a recent experience illustrates some of the difficulties which we are sure to encounter in adopting it. A proofreader for example, of a manuscript recently published, substituted the word conception for conceptus in a part of the manuscript. Because of delay in the mails and because of other things, an opportunity was not afforded to make the necessary changes before publication. Hence, in one sentence in which it was stated that a number of conceptuses were examined, it now is stated that so many conceptions were examined. The latter may imply: (1) that a given number of fertilizations were examined, (2) or that a certain number of individuals in the early months of pregnancy were examined, (3) or that abortuses were examined. Yet, none of these things was meant. None of the American medical or nonmedical dictionaries accessible to me here at Stanford University defined the word conception as referring to the thing conceived, except in the sense of mental conception. Murray, however, does recognize the use of the word in the sense of embryo or fetus, but since this usage is rare even in English medical literature and also foreign to us, it probably would be wiser not to try to revive an old meaning. Moreover, such a revival would not obviate the possibility of misunderstanding. Hence, an unequivocal term such as conceptus seems preferable.

At present the word embryo frequently is used to designate conceptuses in the earlier months of gestation. It is used still more frequently to designate merely the body of the developing individual during the early stages, in contrast to the word fetus, which is applied in the later months of pregnancy. Hence, we have need for still another term to be used in common for the embryonic disc, the embryo, or the fetus. My former colleague, Dr. Adolph Schultz, has kindly called my attention to the word kyema. I was happy to learn from my friend Professor Foster, that it is excellent Greek and was used in the proposed sense by no less than Plato[1] himself. It was used in this sense also by Æschylus.[2] Professor Foster, however, suggests, that we preferably spell the word cyema. This term of Plato's also has the advantage of being available for comparative embryology and of being adapted to meet such needs as are represented by the terms cyemetric and cyemology. At present, no one can know what is meant when one says that there are no embryonic remnants present. The addition of the word cyema would largely avoid this difficulty. It is not my purpose to suggest that the long established term embryology shall be abandoned or displaced, in spite of the fact that the derivative embryometrics is somewhat misleading. The same thing, to be sure, will remain true of the term embryology as long as we continue to use the term embryo in a restricted sense and in contrast to fetus. In these respects the derivatives of cyema would be preferable, it seems to me.

Although the word abortion is available to designate the individual thing or the material aborted, it has not been the custom to use it in this inclusive sense. As now used, the word invariably is restricted to apply to the act itself. To use it in a double sense would lead to some confusion. Since blood clot, pus, decidua and mucosa, usually not only are included with but frequently also surround the entire conceptus, one could use the word abortus to designate all the material expelled during abortion. It is only in this or a similar way that one can avoid the use of such misleading words as mole, and such expressions

[1] Rep. 461C.

[2] Aesch. Eum. 659.

as the entire mass, embryonic mass, abortion mass or quite inaccurately even the chorionic vesicle when the latter is surrounded by a certain amount of decidua and blood clot even!

I trust that readers will generously remember that I am aware that change may not imply immediate improvement or progress, but the absence of it surely never does. I realize full well that the use of unnecessary terms is to be avoided, but this is equally true of awkward circumlocution and misunderstanding. When anyone writes or says, at present, that no embryonic remnants were present or that he has seen an interesting abortion, it is impossible to know what he means. Although the word embryo could by common consent be used in the proposed sense of cyema, long usage probably would make such an attempt futile for this reason alone. The introduction of this term and of the others suggested does not needlessly change old usage. It abrogates nothing save confusion.

Since I recently happened upon the term cubus, which the ancient Greeks (Athenæus) used for what I have designated as the preiliac fossa[3] in bovines, sheep, goats and horses, I take pleasure in recording this incidental finding. At the time I suggested the above term nothing but the German designation "Hungergrube" was known to me. None of the works on veterinary medicine and anatomy in English, which were accessible to me gave a name for this fossa. Since the term cubus seems rather far fetched, at least to one unfamiliar with its origin, I can not recommend the term cubical fossa.

At the suggestion of the late Professor Mall, who was ever ready to welcome and accept whatever answered a need, I am prompted also in this connection to say a few words in explanation and justification for several titles I have used in scientific papers. One of these titles is the old one of Spolia Anatomica.[4] Some of my friends have taken exception to this title and others have felt prompted to twit me! The objection apparently is to the word *spolia*. I used it in an inclusive sense to represent observations and descriptions of anomalies from the dissecting room and such as I happened upon while engaged in investigation. All of the things reported under this head were essentially anatomic windfalls. Since they were incidental to the work of the student of anatomy and the dissecting room, or that of the anatomist in his laboratory, they certainly could with entire propriety be called by-products or leftovers—spolia. That is exactly what they were. This use is an old and not a new one. In fact, such use is not new even in modern literature of anatomy. If I am informed rightly, the skin, horns and hoofs, and so forth, were regarded as the spolia or by-products of slaughtering, and this they remain to this day. Likewise, the shield and sword and armor of the fallen combatant were the spolia or the by-products of the gladiatorial combat. They too were removed in the spoliary or spoliarum. And even in the chase and, for that matter, in many wars of the *past* the spoils were the by-products, not the aim. To have interchanged the two is a very recent and lamentable thing. I am also reminded, and very gladly so, that there still are those to whom the spoils of angling and the chase remain incidental and the love of these sports, the aim.

While I must insist then that the use of the term spolia anatomica, is strictly correct, I can not commend it very highly. It tells no more about the content of a paper than the wastebasket does of its content, and it makes proper indexing difficult. Consequently, unless, as generously done by the "Index Medicus," all sub-titles of an article so designated are listed separately, no one knows what has been reported under such an omnibus title. Usually the things so reported really do not attract the attention of those who would be interested in them. Furthermore, in these days of counting titles in order to gage a man's productivity, one inclusive title makes a very poor showing in place of three or four scores of separate ones. Yet in spite of all these disadvantages, I chose the term advisedly and

[3] *Am. Jr. Anat.*, Vol. 21, 1917.

[4] *Jr. Anat. Physiol.*, Vol. 48, 1914; *Anat. Rec.*, Vol. 9, 1915, and Vol. 12, 1917.

do not propose to desert it merely because I used it in other than the predominating sense.

I have also been guilty of using the term osteology redivivus.[5] I did this with full knowledge of the fact that well recognized English writers had used it in similar connection in other than anatomic literature. George William Curtis used it thus in American literature. Nor did I stop here for I sought the advice and the approval of one of the foremost philologists in this country, a man of international standing for several decades, who after looking the matter up said I would be following good precedent in using it.

I have used these terms then and am suggesting others now, not because I desire to appear versed in Latin and Greek, but because they express what I want to say, and fill a need. They are free as the mountain breezes and at the service of anyone who, like myself, knows none better. May those who do, make me and the science of embryology their debtors.

A. W. MEYER

STANFORD UNIVERSITY

[5] *Anat. Rec.*, Vol. 8, 1914.

THE ROOSEVELT WILD-LIFE FOREST EXPERIMENT STATION

NEVER before in America, and for that matter, possibly, never before in the world, has there been a forest biological station devoted primarily or exclusively to the study of every phase of forest wild life. The establishment of such a station at The New York State College of Forestry, at Syracuse University, is thus an event of considerable general interest and importance, not only to those interested in the conservation of wild life, to foresters, and to zoologists in general, and particularly to field naturalists, but in addition to many others who are interested in the ecology of fish, birds, game, fur-bearing animals, and other kinds of forest wild life. This station, named in honor of the man, a native of the state of New York, who, with Gifford Pinchot, did more for forestry and forest wild life than any one else has done, thus becomes a very appropriate memorial to Theodore Roosevelt. Further, this station is the direct outcome of plans, started in December, 1916, with the cooperation and hearty support of Theodore Roosevelt, for the investigation of forest animals.

The establishment of the present station, as a memorial to his father, has had the hearty support of Lieutenant-Colonel Theodore Roosevelt, Jr., who writes:

> I think your ideas are excellent and I know that my father would appreciate no type of memorial more than that which you suggest, as you know it was one of the subjects that was always uppermost in his mind. I give my consent without reservation for the use of his name for this memorial.

As suggested above this idea of a Roosevelt Wild Life Memorial is the only one of the suggested memorials, known to me, which comes so near the *direct approval* of Theodore Roosevelt. Plans for the study of forest wild life, as stated above, were presented to him in December, 1916, and received his characteristic approval with enthusiasm and energy. He suggested that they be taken up "in a big way," commensurate with their importance, and in these words we know the kind of memorial which is worthy of the man.

In New York state the forest land and fresh water area nearly equals that of the tilled land, so that the proper care, management, and use of forest wild life is one of the large economic and social problems, and it is this same wild life which is one of the two main sources of income which finances conservation in New York state. Thus on economic grounds alone New York state would be fully justified in establishing such a station. The character of the problems involved in the study of forest wild life in these millions of acres of forest lands and waters are similar in many respects to those involved in varied wild life preserves and sanctuaries, in our National Forests and in our National Parks. The function of this station, as defined by the New York law is:

> To establish and conduct an experimental station to be known as "Roosevelt Wild-Life Forest Experimental Station" in which there shall be maintained records of the results of the experi-

ments and investigations made and research work accomplished; also a library of works, publications, papers and data having to do with wild life together with means for practical illustration and demonstration, which library shall, at all seasonable hours, be open to the public.

Furthermore, the duties of the station are to make "investigations, experiments and research in relation to the habits, life histories, methods of propagation and management of fish, birds, game and food and fur-bearing animals and forest wild life."

This is a very comprehensive program and it opens up an immense field for investigation, for demonstration, and for the training of forest and park naturalists. Not the least important feature of the plan is that it provides for an establishment which will supplement the other equipment of the college in such a manner as to make unique facilities not only for research on wild life, but likewise for the training of students who wish to specialize in this kind of ecological study, either for the purposes of becoming technical forest naturalists and investigators, or as foresters interested in the development and practical management of fish and game in forests, and as well for similar work in parks, particularly in the National Parks.

The law passed in the Legislature so late in the session that no special appropriation was made available, but the experiment station funds of the college are available to make a start at once. Quarters will be provided at the college and at the college experiment station at Syracuse.

Such a wild life repository library as is contemplated by the law, would be unique as no such special library has been assembled in America, and would be of much general value.

As examples of the kind of problems which need attention, the following may be cited: We need to know much more about the life histories and habits of all of our large game, fur-bearing, and predaceous forest animals. Such a knowledge is an essential basis for sane legislation, and the proper care and use of such animals. Even such a common forest animal as the porcupine is really but little known. There are numerous problems on the relation of birds to forests that require detailed study. This is equally true of the game birds. The problem of stocking lakes and streams with game fish involves a great number of zoological problems that have not been investigated intensively. There are also many unsolved problems in connection with the production of food from forest lands and waters, involving many kinds of wild and even domestic animals, which can be best studied at such a station.

It is expected that this memorial, while receiving support from the Legislature of New York, will draw support as well from those private citizens throughout the nation who are admirers of Roosevelt and his conservation policies, and who are also in sympathy with the study of game and other wild life, and who recognizing the need of such a station will enable it to extend its work beyond the borders of the state.

The establishment of this state memorial has been brought about by the friends of Mr. Roosevelt and those of the State College of Forestry, and from their very inception these plans have had the hearty support of the dean of the college, Dr. Hugh P. Baker.

Charles C. Adams,
Director

The Roosevelt Wild Life Forest
Experiment Station of the
New York State College of Forestry,
at Syracuse University

GABRIEL MARCUS GREEN[1]

Gabriel Marcus Green was born in the city of New York, on October 19, 1891. He attended the public schools of that city, graduating from Public High School No. 4 in 1904 as valedictorian of his class. He then entered the high school department of the College of the City of New York and in 1911 graduated from the college at the head of his class. In 1909 he received the Belden

[1] Minute on the life and services of Dr. Green placed upon the records of the faculty of arts and sciences of Harvard University at the meeting of April 1, 1919.

Mathematical Prize; in 1909 and 1910, the Pell Medal for the highest rank in all subjects; and in 1910 and 1911, the Kenyon Prize for Distinction in Pure and Applied Mathematics. He pursued his graduate studies at Columbia University, where he took the degree of master of arts in 1912 and doctor of philosophy in 1913. His thesis was entitled "Projective Differential Geometry of Triple Systems of Surfaces," and was a remarkable achievement, for he had, unaided, made himself master of this new field of geometry by independent study and added to it an important contribution. He was a member of the Phi Beta Kappa and Sigma Xi societies.

Dr. Green returned to his college the following year as instructor in mathematics. In 1914 he was appointed to an instructorship at Harvard, and in 1916 became a member of the faculty. Clear, interesting, vivacious, he imparted to his hearers an understanding of the subjects treated which served as a firm foundation for future study. In research he was exceedingly productive, and, brief as was the span accorded him for his scientific labors, he had by a notable series of memoirs contributed largely to the present development of his special field of projective differential geometry.

His appreciation of music was extraordinary. Although he had never had formal instruction, he had made himself a skilled pianist, and had sought expression in original compositon.

His disposition was genial. He was emotional and sensitive, and at the same time sympathetic and unselfish. For such a nature, the craving for the harmony of a homogeneous civilization with its uniform ethical ideals and the mutual understanding of its members must have been intense. Green found himself a member of two civilizations, and he was not spared the pain of incessant clashes of their ideals and habits of thought. But the fineness of his spirit and the nobleness of his character were such that, in the turmoil, he remained serene and grew in strength of mind and soul. High ambition and untiring energy, combined with great intellectual gifts, and a fine sense of duty toward his fellowmen, were the basis of his success.

An attack of influenza was followed by pneumonia, and he died at the Stillman Infirmary on January 24, 1919. The department lost in him a faithful fellow-worker and friend; the faculty, a teacher of unusual power, and a scientist of high achievement and higher promise.

WILLIAM F. OSGOOD,
LEO WIENER,
DUNHAM JACKSON,
Committee

SCIENTIFIC EVENTS

INTER-ALLIED COOPERATION IN CHEMISTRY[1]

PROFESSOR MOUREU presided over the recent conference in Paris, and among his French colleagues were Professors Haller, Béhal and Matignon, MM. Kestner, Poulenc, Marquis and Gérard. The British delegates were Professors Louis, Sir William Pope, Messrs. Chaston Chapman, W. F. Reid, E. Thompson and S. Maill. America was represented by Mr. Henry Wigglesworth, Lieutenant-Colonels Bartow, Norris and Zanetti, Dr. Cottrell and Major Keyes; Italy by Senator Paternò, Drs. Pomilio, Giordani and Parodi-Delfino; and Belgium by MM. Chavanne and Crismer.

It was unanimously decided to form an Inter-Allied Federal Council of not more than six representatives of each of the countries mentioned above, the members to hold office for three years, one third to retire annually and be eligible for reelection. The executive body is to consist of a president, a vice-president, and a general secretary. Mr. Jean Gérard will provisionally act as the secretary. In addition to the council a consultative committee will be formed, consisting of as many sections as may be necessary to secure the complete representation of pure and applied chemistry. The objects of the confederation are: To strengthen the bonds of esteem and friendship existing during the war between the Allied peoples; to organize permanent cooperation between the associations of the Allied nations; to coordinate their scientific and technical resources; and to contribute

[1] From *Nature*.

towards the progress of chemistry in the whole of its domain.

Neutral countries may be admitted later. The next meeting of the conference will be held in London on July 15–18, that being the date of the annual meeting of the Society of Chemical Industry.

So far as Britain is concerned, the choice of representatives and the supervision of the arrangements for the first meeting will be in the hands of the Federal Council for Pure and Applied Chemistry, of which Sir William Pope is president and Professor H. E. Armstrong the honorary secretary. Until the various nations concerned have chosen their representatives, little can be done, but Sir William Pope and Professor Louis are provisionally acting as the British representatives, and are in communication with their French colleagues.

The meeting in Paris was held under the auspices of the French chemical societies, especially the Société de Chemie Industrielle, the president of which, M. Paul Kestner, presided at some of the meetings.

THE BRITISH IMPERIAL ANTARCTIC EXPEDITION

Plans are being prepared for another Antarctic expedition, which will sail in the famous ship, *Terra Nova,* and be assisted by the latest improvements in aviation and wireless telegraphy. The organization is already in an advanced stage.

It will be known as the "British Imperial Antarctic Expedition," its leader being Mr. John L. Cope. Mr. Cope's name is well known in connection with expeditions to the Antarctic. He accompanied the Imperial Trans-Antarctic Expedition, 1914–17 as surgeon and biologist to the Ross Sea party, and was one of the party of nine who were left on the Great Ice Barrier to lay deposits after the Aurora had broken away from her moorings. Since returning to England Mr. Cope has served in the R.N.V.R. as a lieutenant, but he has never abandoned the idea of organizing a further venture at the earliest possible date.

Arrangements are so far advanced that the expedition will be able to leave England in June, 1920, and Mr. Cope states that the expedition will return in 1926. During the six years continuous communication is to be maintained with the centers of civilization by means of wireless equipment.

The main objects of the expedition will be:

1. To ascertain the position and extent of the mineralogical and other deposits of economic value known to exist in Antarctica, and arrange for their practical development as a further source of imperial wealth.

2. To obtain further evidence of the distribution and migration of the whales of economic value, and to create a British industry.

3. To investigate the meteorological and magnetic conditions of the Ross Sea area and at Cape Ann (Enderby Land) in connection with their influence on similar conditions in Australasia and South Africa, respectively. Such results have been proved of great value by the stations established by the Argentine government in the South Orkneys and by that established on Macquarie Island by the commonwealth of Australia, which has been given up owing to the war.

4. Generally to extend knowledge of Antarctica, especially with a view to obtaining further scientific data of economic importance.

Mr. Cope states that arrangements are being made to take an aeroplane to assist in surveying the interior of the continent. With this machine even a flight to the South Pole is contemplated.

The reason for calling the enterprise the "British Imperial Antarctic Expedition" is that the efforts of Mr. Cope and his comrades will be directed solely for the benefit of the British Empire. The temporary headquarters of the expedition are at 17, Somerset Street, W-1.

OUTLINE MAP OF THE UNITED STATES

The United States Coast and Geodetic Survey has completed a new outline map of the United States on the Lambert conformal conic projection, scale 1-5,000,000.

This map is intended merely as a base to which may be added any kind of special information desired. The shore line is compiled from the most recent Coast and Geodetic Survey charts. State names and boundaries, prin-

cipal rivers, capitals and the largest cities in the different states are also embodied.

The map is of special interest from the fact that it is based on the same system of projection as that employed by the armies of the allied forces in the military operations in France. To meet those requirements and at the request of the army, special publications were prepared by the Coast and Geodetic Survey.

Many methods of projection have been designed to solve the difficult problem of representing a spherical surface on a plane. As different projections have unquestionable merits as well as equally serious defects, the announcement states, any region to be mapped should be made the subject of special study and that system of projection adopted which will give the best results for the area under consideration.

The Mercator projection, almost universally used for nautical charts, is responsible for many false impressions of the relative size of the countries differing in latitude, according to the survey statement. The polyconic projection, widely used and well adapted for both topographic and hydrographic surveys, when used for the whole of the United States in one map has the serious defect of unduly exaggerating the areas on its eastern and western limits. Along the Pacific coast and in Maine the error in scale is as much as 6½ per cent., while at New York it reaches 4¼ per cent.

The value of the new outline map on the Lambert projection can best be realized when it is stated that it shows that throughout the largest and most important part of the United States, that is, between latitude 30½ degrees and 49 degrees, the maximum scale error is only one half of 1 per cent. This amount of scale error of one half of 1 per cent. is frequently less than the distortion due to the method of printing and to changes from the humidity of the air. Only in southernmost Florida and Texas does this projection attain its maximum error of 2 1-3 per cent.

The Lambert projection is well adapted to large areas of predominating east and west dimensions in the United States where the distance across from east to west is 14.5 times that of the distance north and south.

The strength of the Polyconic projection, on the other hand, is along its central meridian. The merits and defects of the two systems of projection may be stated in a general way as being at right angles to each other.

Special features of the Lambert projection that are not found in the Polyconic may be stated briefly as follows:

1. The Lambert projection is conformal—that is, all angles between intersecting lines or curves are preserved, and for any given point (or restricted locality) the ratio of the length of a linear element on the earth's surface to the length of the corresponding map element is constant for all azimuths or directions in which the element may be taken.

2. The meridians are straight lines, and the parallels are concentric circles.

3. It has two axes of strength instead of one, the standard parallels of the map of the United States being latitudes 33 degrees and 45 degrees, and upon these parallels the scale is absolutely true. The scale for any other part of the map, or for any parallel, can be obtained from special publication number 52, page 36, U. S. Coast and Geodetic Survey. By means of these tables the very small scale errors which exist in this projection can be entirely eliminated.

The map measures 25 inches by 39 inches and will be sold by the government at 25 cents.

THE LECONTE MEMORIAL LECTURE IN THE YOSEMITE, 1919

THE University of California through its university extension division will offer free to the public a course of scientific lectures in the Yosemite Valley during June and July, 1919. These are to be known as the LeConte Memorial Lectures in the Yosemite in honor of the name of Joseph LeConte, the famous naturalist and geologist who was for many years a member of the faculty of the University of California. The lecturers and topics for 1919 and the tentative dates are as follows:

I. Professor W. L. Jepson, department of botany, University of California.

1. The Origin and Distribution of But-

tercups in Yosemite, Tuesday, June 24.
2. The Biology of the Chaparral, Thursday, June 26.
3. The Ancestry of the Yosemite Pines and Sequoias, Friday, June 27.

II. Professor Frederick William Bade, lecturer, literary executor of John Muir.
1. John Muir, Nature and Yosemite, Tuesday, July 1.
2. Muir's View of the Valley's Origin Thursday, July 3.
3. Muir's Services to the Nation, Friday, July 4.

III. Dr. F. Emile Matthes, geologist, U. S. Geological Survey, Washington, D. C.
1. Origin of Yosemite Valley, as Indicated in the History of its Waterfalls, Tuesday, July 8.
2. The Highest Ice Flood in the Yosemite Valley (to be delivered at Glacier Point) Wednesday, July 9.
3. The Origin of the Granite Domes of Yosemite, Saturday, July 12.

IV. Professor A. L. Kroeber, department of anthropology, University of California.
1. Tribes of the Sierra, Friday, July 11.
2. Indians of Yosemite, Saturday, July 12.
3. Folk-lore of Yosemite, Sunday, July 13.

It is planned to give most of the lectures at the Village of Yosemite, probably in the pavilion or the open air. Certain of the lectures, especially those by Professor Jepson and Dr. Matthes, will be delivered at places in Yosemite which give concrete illustration of the scientific subjects under discussion.

SCIENTIFIC NOTES AND NEWS

Dr. Vito Volterra, professor of mathematical physics in the University of Rome, will deliver a series of six lectures on the Hitchcock Foundation at the University of California in August or September.

Dr. W. W. Campbell, director of Lick Observatory of the University of California, has been named head of an American delegation of astronomers that will attend the international meeting in Brussels in July.

Lieutenant Colonel John R. Murlin, Sanitary Corps, U. S. Army, who has been in charge of the Section of Food and Nutrition of the Surgeon-General's Office since September, 1917, has been discharged from the service to take up his work as the head of the department of vital economics at the University of Rochester. The work of the Section of Food and Nutrition is now under the charge of Major R. G. Hoskins, Sanitary Corps, U. S. Army.

Professor Anton Julius Carlson, chairman of the department of physiology at the University of Chicago, who as a major in the Sanitary Corps of the United States Army inspected American camps in England and is now a member of the American Relief Administration in France, will take the field again for the American Relief Administration, probably going up to Finland, and returning by Esthonia, Lettonia, Lithuania, Poland, Roumania and Vienna.

Dr. W. A. Cannon, of the department of botanical research of the Carnegie Institution of Washington, has just returned to this country from an absence of a year in central Australia. While abroad he studied the plants and plant conditions of the more arid portions of southern Australia, including the Lake Eyre Basin, a portion of the Flinders Ranges, and southwestern South Australia contiguous to the Nullarbor Plains.

Dr. C. H. T. Townsend sailed, early in April, for Brazil, where he has accepted a position as entomologist for the Brazilian government. Dr. Townsend has been with the Bureau of Entomology and has spent most of his time studying the Muscoid Diptera.

Mr. Frank C. Baker, curator of the museum of natural history of the University of Illinois, will spend a portion of the summer at Winnebago Lake, Wisconsin, conducting

molluscan studies in the interest of the Geological and Natural Survey of Wisconsin.

DR. J. H. GRISDALE, who has been for several years the director of the Experimental Farms Branch of the Dominion Department of Agriculture at Ottawa, has recently been appointed to the position of deputy minister of agriculture.

DR. SAMUEL C. PRESCOTT, of the Massachusetts Institute of Technology, formerly major in the Sanitary Corps, U. S. A., has been appointed expert in charge of dehydration investigations in the Bureau of Chemistry, Department of Agriculture, and will continue the investigations on this subject carried on during the war under the direction of the War Department.

C. M. WOODWORTH has resigned as instructor in genetics at the University of Wisconsin in order to take a position with the Bureau of Plant Industry, U. S. Department of Agriculture. He will devote his attention principally to a study of disease resistance in flax. The field experiments will be mostly in North Dakota, but Mr. Woodworth will retain Madison, Wis., as his permanent headquarters.

CAPTAIN S. T. DANA has resumed his duties with the Forest Service as assistant chief of forest investigations. During the war he was on the general staff as secretary of the army commodity committee on lumber, and in charge of determining wood requirements of the army.

W. FAITOUTE MUNN, formerly chemist in charge at the Baker and Adamson Works of The General Chemical Company, Easton, Pa., has accepted the position as chief chemist for The Brewster Film Corporation of East Orange, New Jersey.

PROFESSOR CHARLES E. FAY, of Tufts College, Massachusetts, president of the American Alpine Club, and Henry G. Bryant, of Philadelphia, have been elected honorary members of the French Alpine Club.

COLONEL E. LESTER JONES, superintendent of the U. S. Coast and Geodetic Survey, has been made by the king of Italy an officer of the Order of S. S. Maurizo e Lazzaro.

SIR ERNEST RUTHERFORD, recently elected Cavendish professor of experimental physics at the University of Cambridge, has been elected to a fellowship at Trinity College.

THE British Electrical Research Committee has appointed Mr. E. B. Wedmore as director of research.

THE British Institution of Civil Engineers has made the following awards for papers read and discussed at the meetings during the session 1918–19:—A Telford gold medal to George Hughes (Horwich), a Telford gold medal and an Indian premium to R. B. Joyner (Bombay), a Watt gold medal to W. S. Abell (London), a George Stephenson gold medal to the Hon. R. C. Parsons (London), a Webb prize to F. E. Gobey, (Horwich), Telford premiums to James Caldwell (London), H. B. Sayers (London), J. Reney Smith (Liverpool), and F. W. Scott (Benoni, Transvaal), and a Manby prize to E. L. Leeming (Manchester).

PROFESSOR R. KOBERT died on December 27, at sixty-four years of age. He was professor of pharmacology at Rostock.

THE death of Dr. Edmund Weiss, director of the Vienna Observatory for thirty-two years, which occurred in 1917, was recently announced by the Paris Academy of Sciences of which he was a correspondent.

THE death is announced of Dr. José Penna, professor of epidemic diseases at the University of Buenos Aires.

THE British Scientific Products Exhibition, arranged by the British Science Guild, will be open in the Central Hall, Westminster, from July 3 to August 5. Its objects are to illustrate recent progress in British science and invention, and to help the establishment and development of new British industries.

WE learn from *Nature* that at a recent meeting of the council of the Marine Biological Association of the United Kingdom it was announced that Dr. G. P. Bidder and Mr. E. T. Browne had each undertaken to contribute a sum of £500 towards a fund for the extension of the laboratory at Plymouth. The new building will be commenced at once, and the

scheme, when completed, will provide both a new and larger aquarium and special laboratories for physiological work.

A MESSAGE received from Rome states that in the province of Cattaniselta in the Island of Sicily, immense deposits of potash have been discovered and the preliminary investigations are said to establish these as the richest in the world. The exploitation of these deposits, if the first reports receive the confirmation hoped for, would make it quite unnecessary to have recourse to the German supplies.

MOSQUITOES representative of all species occurring at camps or posts where troops of the United States are stationed are to be collected for the Army Medical Museum in Washington. At present the collection is incomplete and medical officers have been directed to see that collections of these insects are made at the times and in the manner described in circular instructions being published. Collections of mosquitoes are to be made at each station at least biweekly, at three periods during the twenty-four hours, early morning from 5 to 6 A.M., midday, and after 7 P.M. The time of collection will vary in different latitudes, but observation will determine the time when the insects are most prevalent at each locality. They are to be collected by means of a suitable killer or by mosquito traps. The "chloroform tube" is the best and most easily obtained killer, and mosquito traps are also useful. Shipments of the mosquitoes in lots of 25 each in specially prepared boxes are to be mailed by medical officers at camps to the curator, Army Medical Museum, Washington, D. C.

IN announcing on March 20 the reopening of the Zoological Garden and the Aquarium, which had been closed by the military during the Berlin riots, the Berliner *Tageblatt*, as quoted in a press dispatch, notes the fact that because of the increased expense of operation the price of admission to the Zoological Garden will be advanced to 36 cents on week days and 24 cents on Sundays on April 1. In order to give the poorer inhabitants of the German capital a chance to enter the Garden there will be two "cheap Sundays" a month when the entrance fee will be only 12 cents, against the former figure of 7 cents. Since 1910 the Berlin City Council has been subsidizing the Garden at the rate of about $5,000 a year and the Aquarium with about $6,000.

THE Virginia deer is said to have been unknown in Nova Scotia until about 1888, and was afterwards introduced. However, bones of this animal have now been found in two widely separated prehistoric Indian shell-heaps in that province by archeologists of the Geological Survey, Canada. Toe bones have been found in a shell-heap near Mahone Bay on the outer coast by Mr. W. J. Wintemberg, in 1913, and a toe bone was also found in a shell-heap on Merigomish harbor on the north coast of Nova Scotia by Mr. Harlan I. Smith, in 1914. The identification of these bones has been confirmed by Dr. Gerrit S. Miller, of the United States National Museum. Other bones and teeth, supposedly of the same species, but not submitted to Dr. Miller, have also been found in these heaps.

UNIVERSITY AND EDUCATIONAL NEWS

THE General Education Board, founded by John D. Rockefeller, has made an appropriation of $500,000 toward a fund of two million dollars to be raised to endow a graduate school of education for Harvard University. The new fund will be named in honor of Dr. Charles W. Eliot, president emeritus of Harvard University.

DR. JAMES YOUNGER and his wife have given £30,000 to provide the University of St. Andrews with a memorial hall, to be used for university purposes.

THE sum of £10,000 has been given to the Cape University by the National Bank of South Africa.

DR. W. J. CROZIER has been appointed assistant professor in the department of zoology of the University of Chicago.

DR. E. W. LINDSTROM, who returned a short time ago from France, where he was in the aviation service, has been appointed assistant professor of genetics in the college of agriculture at the University of Wisconsin.

DR. BENJAMIN PALMER CALDWELL, formerly of Tulane University, New Orleans, and for the past three years professor of chemistry in Oglethorpe University, Atlanta, has accepted the professorship of analytical chemistry in the Polytechnic Institute of Brooklyn, and will begin his work there in the autumn.

AT the University of Saskatchewan, Assistant Professor L. L. Dines has been promoted to a full professorship of mathematics.

DR. ALEXANDER MCPHEDRAN has resigned the professorship of medicine in the University of Toronto medical department, and Dr. Duncan A. L. Graham has been appointed his successor. The *Journal* of the American Medical Association states that recently Sir William Osler invited professors of medicine in the United Kingdom to a dinner in Dr. Graham's honor, at which it was stated that Dr. Graham was the first whole-time professor of medicine appointed in the British empire. The appointment was made possible by the munificence of Sir John Eaton, Toronto. As a result all physicians in the service of the medical department at the university will resign, so that Dr. Graham will have a free hand in selecting his own staff.

DR. F. A. LINDEMANN has been appointed to succeed Professor Clinton in the chair of experimental philosophy at the University of Oxford.

DR. S. W. J. SMITH, F.R.S., assistant professor at the Imperial College, South Kensington, and for many years secretary of the Physical Society of London, has been elected to the Poynting chair of physics in the University of Birmingham.

DISCUSSION AND CORRESPONDENCE

THE CUMBERLAND FALLS METEORITE

ON April 9, last, a brilliant meteor was seen at mid-day to fall in a northwesterly direction across northeastern Tennessee. Though the sun was shining in this section, observers describe the light from the meteor as exceeding the sun in brightness. Passing over southeastern Kentucky, where the sky was obscured by clouds, the meteor made its presence known by violent detonations, accompanied by the spalling off of fragments. The first of these fell near Sawyer P. O., not far from the Falls-of-the-Cumberland.

The concussions produced by the bolide were terrific, causing buildings to rock, and producting the impression on some that the region was being visited by an earthquake. The first news of the phenomenon printed in the local papers so recorded it. Realizing that the detonations heard and shocks felt were due to the concussions produced by a falling meteorite the writer through the medium of these local papers, and by correspondence with postmasters and telegraph operators throughout the district affected has succeeded in determining the path of the meteor and has secured a number of the fragments. The main mass appears to be yet undiscovered. Falling in the most rugged and sparsely settled portion of southeastern Kentucky the prospects of this main mass being found are not promising.

The general azimuth of the meteor in its fall seems to have been about north 30 degrees west. Over Kentucky it paralleled roughly the line of the Cincinnati Southern Railroad. An interesting incident in this connection is the record of the progress of the meteor kept by the telegraph and telephone operators in the railroad stations and signal towers. They actually put it on a schedule something like an "extra," and heralded to operators ahead the arrival opposite them to the east of this mysterious visitor. The operator on another branch of the Southern Road at Coal Creek Tennessee saw the meteor disappear to the northwest at 12:21 P.M. The tower man at Tatesville, Ky., heard violent detonations to the east, and felt his tower rock at 12:27. Telephoning ahead to the Danville, Ky., operator, while yet talking to him he heard him reply at 12:30 "I hear it coming now." The distance from Tatesville to Danville in an air line is 48 miles. It took the meteor sounds, therefore, 3 minutes to travel this 48 miles. How much of this is due to the rate of sound traveling in air and how much to the north-

west component rate of the falling meteorite can not at present be stated. It seems now to be pretty well established that the meteor never crossed to the west side of the Cincinnati Southern Railroad.

For the forthcoming Bulletin of the Kentucky Geological Survey the writer has delineated upon a map of a portion of southeastern Kentucky the area in which all the fragments of the meteorite will probably be found. At present writing seven pieces ranging in weight from 13 oz. to 5¼ lbs. have been found that by their covering of glaze indicate that the split off from the main mass at a considerable distance from the ground. Fifty-two pieces weighing from less than an ounce up to four pounds have been found that are parts of a mass weighing originally about 31 pounds. This mass was broken into these numerous fragments as the result of falling on top of the conglomerate cliff which forms the walls of the gorge of the Cumberland River below the Falls.

The larger fragments, which split off from the main mass at a considerable height, besides the covering of glaze, have the characteristic pittings of meteorites. They are light gray in color, and exhibit a brecciated structure. A chemical examination of the material of which they are composed, made by Dr. Alfred Peter, of the Kentucky Agricultural Experiment Station, shows it to be mainly the mineral enstatite (silicate of magnesium). Through this is disseminated microscopic particles of nickel-iron and iron combined with sulphur in an amount not exceeding two tenths of one per cent. Small amounts of sodium and calcium are also present. The meteorite would therefore be classed as a chondritic aerolite. It has the same specific gravity as enstatite, 3.18.

Arthur M. Miller
Department of Geology,
University of Kentucky,
May 14, 1919

ON THE AURORAL DISPLAY OF MAY 2, 1919

The notes on this display, in Science, May 23, 1919, lead me to offer the following summary of my observations on it between 8:38 and 10:30 p.m. (75th meridian time), May 2.

There were streamers of increasing prominence from the time I first observed the display at 8:38, until the culmination at 8:50 to 8:55, when the sky from the north-northwest to north by west was covered from about 10 degrees to a height of 45 or 50 degrees with a deep crimson light. The auroral arch, which was unusually narrow and sharply defined below, and at times subdivided in two or three parts, continued with varying brightness and altitude (base about 8 to 15 degrees) till 10:30, at least. There was some moderate streamer display from time to time. The effect of the auroral display was heightened by the sweep of searchlight beams from the south, and by the presence of the relatively new moon in conjunction with Venus.

A very similar display was observed here February 27, 1919, from 8:50 till after 11 p.m., with crimson coloration in the north to an altitude of about 40° at 10:45 to 10:50.

Charles F. Brooks
Chevy Chase,
Washington, D. C.

MEETING OF PLANT PATHOLOGISTS ON LONG ISLAND TO DISCUSS POTATO DISEASES

The summer potato inspection tour and conference arranged by the Advisory Board, American Plant Pathologists, will be held on Long Island from June 24 to 27, 1919 for the special purpose of studying potato mosaic and leaf roll. The members of the party will meet at the Griffen House, Riverhead, Long Island, Tuesday evening, for dinner, after which there will be a meeting at the Court House.

The next day will be spent in a tour of inspection of test plots of potatoes on the north side from Riverhead to Orient Point. There will be an informal conference at Riverhead during the evening. On June 26, a trip will be made to the south side, the day being spent in the inspection of an experimental test plot at Wainscott, and in conferences at Southampton. The party will then take an evening train to Garden City, Nassau County. The following day, June 27, will be spent in the

inspection of experimental plots at Glen Head and in visiting a few of the large truck farms for which Nassau County is famous. An evening meeting will be held at New York City.

The experimental test plots consist of plantings of healthy, mosaic, and leaf roll seed tubers obtained from northern and central New York, Vermont, Maine, Long Island, Prince Edward Isle, and Bermuda. Records of the behavior during 1918 of the parent plants will be compared with the behavior this year of the progeny. Much of this seed has been planted under the direction of pathologists who have been investigating these diseases. An opportunity will also be afforded to compare fields planted with seed from the north and with Long Island grown seed; of fields planted with mature and with immature seed.

Noted potato pathologists from the United States, Canada and Bermuda will be present to explain the various tests, to point out the characteristic symptoms, and to discuss the results observed here as well as other experiments they have conducted. The bearing of these observations and studies on seed certification will be given consideration at the conferences held during the tour. Invitations have been extended to a pathologist of England, of Ireland and of Holland, and some assurance has been received that one or more of these men will be present. It is expected by means of these observations and discussions that considerable light will be thrown upon the nature and behavior of these serious and baffling diseases and that thereby measures for control will be better understood.

Every pathologist interested in potatoes or in these particular types of diseases should plan, if possible, to attend, for the occasion is unusual in material available for study and in instruction presented. Horticulturists, agronomists and other persons interested are invited to join the pathologists.

Persons planning to attend should at once inform the writer in order that accommodations may be reserved for them. The farmers of Long Island have generously offered to provide the means of transporting the party about the island.

M. F. BARRUS,
Chairman, Committee of Arrangements

SCIENTIFIC BOOKS

Appendages of Trilobites. By CHARLES D. WALCOTT, Smithsonian Misc., Coll., Vol. 67, No. 4, Cambrian Geol. and Pal., IV., December, 1918, pp. 115–216 + index, Pls. 14–42, Text Figs. 1–3.

IN this recent paper Dr. Charles D. Walcott summarizes his investigations of the appendages of trilobites during the past forty-five years, a research undertaken in pursuance of a promise made to Professor Louis Agassiz in 1873. Since that time, he writes, "I have examined and studied all the trilobites that were available for evidence bearing on their structure and organization."

His summary of 1881[2] is reviewed and corrected, together with later papers discussing his various discoveries in this subject.[3] The highly organized trilobite, *Neolenus serratus* (Rominger), from the Burgess shale quarry opened by Dr. Walcott, near Field, B. C., several years ago, shows most graphically in the ten plates devoted to its illustration the highly specialized development of appendages, which is also figured in plates of the Ordovician trilobites, *Isotelus, Triarthrus, Calymene* and *Ceraurus.* In the figure of *Neolenus* the appendages include antennules, caudal rami, endopodites, epipodites, exopodites, exites and protopodites. The evidence of appendages is supplemented by numerous figured sections of *Ceraurus* and *Calymene.*

[2] The Trilobite: New and Old Evidence Relating to its Organization, *Bull. Mus. Comp. Zool.*, Cambridge, Mass., Vol. VIII., No. 10, 1881, pp. 191–224, Pls. I.–VI.

[3] *Proc. Biol. Soc. Washington*, Vol. IX., 1894, p. 94. *Smithsonian Misc. Coll.*, Vol. 57, 1912, pp. 164, 208, Pl. 24, Figs. 1, 1*a*. *Idem*, 1911, Pl. 6, Figs. 1, 2; 1912, Pl. 24, Figs. 1, 1*a*; Pl. 45, Figs. 1, 2, 3, 4. Text-book Pal. (Zittel), Eastman 2d ed., 1913, Vol. I., p. 701, Fig. 1,343, p. 716, Figs. 1,376, 1,377. *Smithsonian Misc. Coll.*, Vol. 57, 1912, pp. 149–153.

After discussing the mode of occurrence, conditions of preservation, manner of life including method of progression, food, defense and offense, the author describes species with appendages, which include besides the genera already mentioned, *Kootenia dawsoni* (Walcott), two species of *Ptychoparia* including a new one *P. permulta* from the Burgess shale quarry, *Odonotopleura trentonensis* (Hall), *Trinucleus concentricus* Eaton, and an unidentified Ordovician crustacean leg. The work of C. E. Beecher with *Triarthrus* is reviewed in some detail, and a different conclusion arrived at in certain features.

In section two of the paper the structure of the trilobite receives attention, the author again referring to Beecher and other writers including Jaekel, Beyrich, Barrande and de Volborth. He then discusses in detail the appendages, summarizing them as follows:

Cephalic: (1) Antennules, (2) antennæ, (3) mandibles, (4) maxillula, (5) maxilla.
Thoracic:
Abdominal:
Caudal rami:

Further comparisons are with the recent *Anaspides tasmaniæ* G. M. Thomson, a Malacostracan from Tasmania, *Koonunga cursor* Sayce, and *Paranaspides lacustris* Smith, also the parasitic crustacean *Cyamus scammoni* Dall, illustrations of all of which are given. After the extraordinary interest of the finely developed specimens in the plates representing *Neolenus,* attention will be drawn by those of *Isotelus, Triarthrus becki* Green, and other Ordovician trilobites, together with the sections of Cambrian and Ordovician trilobites, and finally the author's conclusions as expressed by several diagrammatic restorations, also sketches of thoracic limbs of trilobites and recent crustaceans, crustacean limbs, and six plates of tracks and trails of trilobites, each adding evidence to the author's deductions as to the appendages.

Some conclusions drawn are that the trilobite's appendages show him to have been a marine crustacean far more highly developed than would have seemed possible in a period so infinitely remote.

In its younger stages of growth a free moving and swimming animal, it later became a half-burrowing, crawling and sometimes swimming animal and moving at times with the flow of the tides and prevailing currents. Eggs have been found both within and free from the body. . . . It was at home on many kinds of sea-bottom and was able to accommodate itself to muddy as well as clear water.

It was intensely gregarious in some localities and widely scattered in others, depending upon local conditions, and habits of the various species.

Trilobites had an ample system of respiration by setiferous exopodites, epipodites, and exites attached to the cephalic, thoracic and abdominal limbs [as shown in restorations of the limbs on plates 34 and 35].

The structure of the gnathobases of the cephalic limbs indicates soft food such as worms, minute animal life and decomposed algæ. . . . The trilobite persisted from far back in pre-Cambrian time to the close of Carboniferous time . . . and left its remains more or less abundantly through about 75,000 feet of stratified rocks.

The paper is profusely illustrated and carefully indexed.

G. R. Brigham

SPECIAL ARTICLES

PRESOAKING AS A MEANS OF PREVENTING SEED INJURY DUE TO DISINFECTANTS AND OF INCREASING GERMICIDAL EFFICIENCY

In the course of investigations on the bacterial black-chaff disease of wheat, under the direction of Dr. Erwin F. Smith, a new method of seed treatment has been discovered which practically eliminates seed injury due to the use of disinfectants, and at the same time renders pathogens on the seed coats more susceptible to the action of the disinfectant. This is accomplished by allowing the seeds to absorb water for a definite period in advance of treatment. The saturation of the cells and cell-walls with water before treatment, by diluting the full-strength disinfectant beyond the point of injury as it enters the tissues, in accordance with the law of diffusion of dissolved substances, is the explanation of the results obtained. Not only is injury to germination prevented, but the germination of seeds thus treated is stimulated, reducing the danger of

seed infection by soil organisms during the sensitive period of germination.

On the other hand, experiments with wheat seeds infected with the black-chaff organism have shown that this method used with formalin will completely destroy the organism on the kernels. After screening and fanning to remove shrivelled grains, the treatment should be made by soaking infected seeds for ten minutes in water then draining and keeping moist for six hours. They are then soaked ten minutes in formalin 1:400 solution (1 lb. to 50 gallons of water) drained, and covered for six hours; then dried over-night and planted next day. If copper sulfate is used, the presoaked seeds are thoroughly wetted in the 1:80 solution (1 lb. to 10 gallons of water) for ten minutes, drained and kept moist twenty minutes, plunged for a moment into milk of lime, dried over-night and planted. The effect of the presoaking with water, besides preventing seed injury, is to stimulate dried and dormant bacteria on the seed coat, into vegetative activity, thereby rendering them more sensitive to the action of the disinfectant which must be applied at the end of the presoak period and of course before the seeds have begun to germinate. This is fully in accord with the established principle that microorganisms in a vegetative condition are more susceptible to destructive agents than when dry and in a resting stage.

The effect of the presoak method of seed treatment with chemical disinfectants is, therefore, two-fold—first, seed injury is prevented by the dilution of the disinfectant as it enters the presaturated seed tissues; second, the efficiency of the disinfectant on the pathogen is increased. In view of the fact that nine different varieties of wheat, also oats, barley and maize, have been treated by this method, using both formalin and copper sulfate, disinfectants of widely different chemical nature, in strong solutions (formalin 1:320 and copper sulfate 1:80) without appreciable injury to germination, it appears probable that the same physiological principles here utilized can be applied to other chemical disinfectants and to the treatment of other seed-transmitted diseases amenable to control by these disinfectants, with variations of course in the length of the presoak period (which is six hours for wheat, barley and oats, and ten to eighteen hours for maize) and of the subsequent disinfectant period, as found necessary for each kind of seed and pathogen.

The use of this method in farm practise involves no radical change in present procedure other than to keep seeds moist for definite periods before treatment. If the use of the presoak method is found efficient for the cereal smuts and other diseases as well as for the black-chaff disease of wheat, it will result in a saving of most of the seed now lost by present methods of treatment and also in increased germicidal efficiency. The formulation of this method, as here reported and later to be given in detail, opens up a wide field for the reinvestigation of practical seed treatment for the control of seed-transmitted diseases by chemical disinfectants.

Harry Braun

Laboratory of Plant Pathology,
Bureau of Plant Industry,
U. S. Dept. of Agriculture

THE AMERICAN PHILOSOPHICAL SOCIETY

The annual general meeting of the society was held from April 24 to 26 and a program of over fifty papers covering a wide range of subjects was presented. The sessions were presided over by the president, Professor W. B. Scott and by vice-presidents G. E. Hale, H. L. Carson and A. A. Noyes.

Two important features were a symposium on the solar eclipse of June 8, 1918, and one on chemical warfare. In the former special attention was given to photographs and their interpretation of the prominences and the coronal arches and streamers obtained by members of the several expeditions sent from the Lick, the Mount Wilson, the Lowell, the Sproul and the Yerkes observatories.

PROGRAM

Thursday Afternoon, April 24, 2 o'clock

William B. Scott, D.Sc., LL.D., president, in the chair

The cosmic force, radio-action: Monroe B. Snyder, director of the Philadelphia Observatory.

The conservation of the natural monuments (illustrated): John M. Clarke, director of depart-

ment of science and State Museum, Albany, New York.

Detection of ocean currents by their alkalinity (illustrated): ALFRED G. MAYOR, director of department of marine biology, Carnegie Institution of Washington, Princeton, N. J.

Ocean currents moving from warm into cold regions are relatively alkaline and their surface waters absorb CO_2 from the atmosphere so slowly that they remain more alkaline than one would expect from their temperature. Conversely cold currents moving into warmer regions retain their relative acidity and part with their CO_2 at so slow a rate that they become warmer than would be expected from their low alkalinity. In tropical regions of the Pacific the surface currents sometimes observed setting toward the eastward, against the prevailing westerly drift, are relatively acid and contain more CO_2 than we would expect from their temperature. The hydrogen-ion concentration of sea water can so easily be detected by using such indicator as thymolsulphonephthalein that the method may prove of service to navigation in detecting the presence of counter currents before the ship has been deflected from its course.

Some oceanographical results of the Canadian Arctic expedition 1913–18: VILHJALMUR STEFANSSON, commander of Canadian Arctic Expedition. (Introduced by Mr. Henry G. Bryant.)

Evolution and mystery in the discovery of America: EDWIN SWIFT BALCH, of Philadelphia.

Benjamin Franklin's art as applied to books for elementary teaching (illustrated): CHARLES R. LANMAN, professor of Sanskrit, Harvard University.

The energy loss of young women during light household muscular activities (illustrated): FRANCIS G. BENEDICT, director of Nutrition Laboratory (Boston) of Carnegie Institution of Washington, and ALICE JOHNSON.

To supply exact information regarding the energy requirements for light household work, the Nutrition Laboratory has begun a study of the heat of women engaged in various domestic activities. The subjects thus far studied have been young women from the domestic science department of Simmons College, approximately 200 women taking part in the experiments. The apparatus used for determining the carbon-dioxide production was a large respiration chamber in which 25 or more individuals could be studied simultaneously. The chamber was well ventilated by forcing outdoor air in at one end and withdrawing the chamber air from the other. A certain proportion of the outcoming air was passed through purifiers which absorbed the carbon dioxide. By noting the gain in weight of these absorbers, a measure of the carbon dioxide given off by the young women could be obtained. The heat production or energy loss was then calculated from the carbon-dioxide production. In all, 12 experiments were made, covering 50 periods 20 or 25 minutes in length. To provide a standard for computing the increase in energy required for the particular household occupation studied, the energy loss of the groups of young women while sitting quietly reading two hours after a light breakfast was determined at the beginning of every experiment in from 1 to 3 periods. As a result of 23 rest periods on 12 experimental days, it was found that the average heat output per kilogram per hour was 1.12 calories. This average figure of 1.12 calories has a specific interest in that it indicates the probable heat production of women sitting quietly under ordinary living conditions with a moderate amount of food in the stomach.

The relative contribution of the staple commodities to the national food consumption: RAYMOND PEARL, professor of biometrics, school of hygiene and public health, Johns Hopkins University.

Hygiene and sanitation as improvised in the zone of operations during the Great War: BAILEY K. ASHFORD, surgeon, U. S. Army. (Introduced by Dr. W. W. Keen.)

Bloodless removal of foreign bodies from the lungs through the mouth by bronchoscopy (illustrated): CHEVALIER JACKSON, attending laryngologist, Jefferson Medical College, Philadelphia. (Introduced by Dr. W. W. Keen.)

Friday, April 25, 10 o'clock

William B. Scott, D.Sc., LL.D., president, in the chair

The new discoveries of extinct animals in the West Indies and their bearing on the geological history of the Antilles (illustrated): WILLIAM D. MATTHEW, curator of American Museum of Natural History, New York.

During the last ten years, explorations in Porto Rico and Cuba have secured the fossil remains of various extinct animals from cave and spring deposits on the islands. Quite large collections have been obtained and it has been possible to reconstruct the entire skeleton of the largest animal found, a ground sloth about the size of a black

bear. Four kinds of ground sloths have been obtained in Cuba and one in Porto Rico; all are related to the large extinct North American ground sloth *Megalonyx*. There are also several kinds of rodents, all of them distantly related to South American groups, chinchillas, spiny rats and perhaps agoutis, and a very remarkable little insectivore which is in a family by itself, and is found both in Porto Rico and Cuba. A giant tortoise, very thin-shelled like the tortoises of other oceanic islands but in some respects very peculiar, a terrapin which still lives on the islands and is closely related to species of the southeastern United States, and a crocodile also still living and near to a Central American species, are the principal fossil reptiles. Although the collections are large, no trace of any kinds of hoofed animals or carnivora have been found, nor any other kinds of rodents save the above South American groups, or of edentates except the one family of ground sloths. The characters of the fauna are believed to prove that the islands have been isolated for a long time, at least since the early Pliocene, and have never had any direct connection with North America; and to indicate that they have probably never had any land connection with South or Central America. There is little question that during the Pliocene or Pleistocene the islands were elevated to or near the borders of their submarine shelves, enlarging and connecting them to some extent, and there is some evidence, but not conclusive, for union of the greater Antilles and as far east as the Anguilla bank.

Characters and restoration of the Sauropod genus Camarasaurus Cope, from the type-material in the Cope collection of the American Museum of Natural History: HENRY FAIRFIELD OSBORN, research professor of zoology, Columbia University, and CHARLES C. MOOK.

Energy conception of the cause of evolution: HENRY FAIRFIELD OSBORN.

The parasitic Aculeata, a study in evolution (illustrated): WILLIAM M. WHEELER, professor of economic entomology, Bussey Institution, Harvard University.

Two recent entomological problems—the pink bollworm and the European corn borer: L. O. HOWARD, chief of Bureau of Entomology, U. S. Dept. of Agriculture, Washington.

Hydration and growth: D. T. MACDOUGAL, director of the department of botanical research, Carnegie Institution of Washington, Tucson, Arizona.

Hydration of agar and agar-protein in propionic acid and its amino-compounds: D. T. MACDOUGAL, director of the Desert Laboratory, Tucson, Arizona, and H. A. SPOEHR.

Sterility and self-and-cross-incompatability in shepherd's purse (illustrated): GEORGE H. SHULL, professor of botany and genetics, Princeton University.

Sexual reproduction is a complex succession of processes, all of which must be coordinated with a considerable degree of perfection in order to be successful. The chain of events leading from the spore mother-cells (oogonia, spermatogonia) through successful fertilization to fully developed viable seeds, may be broken at any one of a number of different points, and may be affected by many agents, both environmental and hereditary. No one should expect, therefore, to be able to bring all cases of sterility under a common viewpoint. In the common shepherd's purse (*Bursa Bursa-pastoris*) there exists a great number of biotypes, each of which has its own characteristics with respect to sterility and fertility, as well as other features, both morphological and physiological. In most of the common forms growing in Europe and eastern North America the lower flowers of the main axis are nearly always entirely sterile. A species common throughout the Pacific coast region of North and South America, and extending at least as far eastward as Tucson, Arizona, has, on the other hand, no sterile flowers at the base of the central raceme. A form similar to the Pacific coast form has also been found in Holland. A cross between the Tucson plants and those from eastern America has given rise to partially sterile hybrids which are characterized by rhythmic succession of sterile and fertile flowers, and there is some evidence that this rhythmic arrangement is under the control of two genetic factors, so that the F_2 from such a cross consists of about one like either parent to fourteen which display again a rhythmic succession of sterile and fertile flowers.

The basis of sex inheritance in Sphærocarpos (illustrated): CHARLES E. ALLEN, professor of botany, University of Wisconsin. (Introduced by Professor Bradley M. Davis.)

Hydrogen-ion concentration of nutrient solutions in relation to the growth of seed plants: BENJAMIN M. DUGGAR, research professor of plant physiology, Missouri Botanical Garden, St. Louis. (Introduced by Professor Bradley M. Davis.)

The relation of the diet to pellagra (illustrated):

E. V. McCollum, professor of bio-chemistry, Johns Hopkins University. (Introduced by Dr. Henry H. Donaldson.)

Friday, April 25, 2 o'clock

George Ellery Hale, Ph.D., Sc.D., LL.D., vice-president, in the chair

The eclipse expedition from the Lick Observatory: some solar eclipse problems (illustrated): W. W. Campbell, director of the Lick Observatory, Mount Hamilton, Calif.

The expedition of the Mount Wilson Observatory to the solar eclipse of June 8, 1918 (illustrated): J. A. Anderson, Mount Wilson Solar Observatory, Pasadena, Calif. (Introduced by Professor John A. Miller.)

A description of the equipment used at Green River was given; the compact arrangement of the different units being the chief feature. Owing to clouds, the results were not what was hoped for. Good photographs of the corona were secured; the wave-length of the green coronal line was quite accurately determined; and certain data of value for future eclipse work were obtained.

The Lowell Observatory eclipse observations, June 8, 1918: prominences and coronal arches (illustrated): Carl O. Lampland, Lowell Observatory, Flagstaff, Arizona. (Introduced by Professor Eric Doolittle.)

The author deals with some of the more important results obtained by the expedition sent sent out by his institution, but especial attention is given to the prominences and the detail of the inner corona. Several conspicuous prominences were shown in the photographs and these are generally surrounded by complex coronal structure. These coronal arches or "hoods" are probably among the most conspicuous and remarkable photographed up to the present time. In the present observations there appears to be no doubt as to the intimate relation between the prominences and the surrounding coronal structure. From a comparison of the observations of earlier eclipses made at different epochs of solar activity it seems probable that complex coronal detail and disturbed regions of the corona around and in the neighborhood of the prominences are more pronounced near sun-spot maxima; that such detail is much less conspicuous and occurs more rarely at or near the minima of sun-spot activity.

The flash spectrum (illustrated): Samuel Alfred Mitchell, director, McCormick Observatory, University of Virginia. (Introduced by Professor John A. Miller.)

Electric photometry of the 1918 eclipse (illustrated): Jacob Kunz and Joel Stebbins, University of Illinois, Urbana, Ill. (Introduced by Professor John A. Miller.)

The Sproul Observatory eclipse expedition: The form of the coronal streamers (illustrated): John A. Miller, director of the Sproul Observatory, Swarthmore College, Pa.

Results of observations of the eclipse by the expedition from the Yerkes Observatory: Edwin B. Frost, professor of astrophysics and director of Yerkes Observatory, University of Chicago.

Self-luminous night haze (illustrated): E. E. Barnard, professor of practical astronomy, University of Chicago.

The author dealt with a little-known feature of the night skies. It is a faintly luminous haze that is sometimes visible on otherwise clear nights when the moon is absent. It does not seem to be connected with any known auroral phenomenon. It seems not to be some form of cirrus or cirro-stratus cloud that for some reason, on rare occasions, is more or less faintly self luminous at night. The source of its light is unknown. When best seen it is quite noticeable as a streaky luminous haze; sometimes it appears in broad sheets. It drifts easterly over the stars and remains visible with a faint steady light for a considerable length of time. Sometimes it seems to be absent for several years. At other times there is a great deal of it. It is seen in all parts of the sky, differing thus from the ordinary auroral phenomena, which are mostly confined to the northern part of the sky.

Photometric measurements of stars: Joel Stebbins, professor of astronomy, University of Illinois. (Introduced by Professor Henry Norris Russell.)

Star clusters and their contribution to knowledge of the universe: Harlow Shapley, Mt. Wilson Solar Observatory, Pasadena, Calif. (Introduced by Professor George E. Hale.)

Tatar material in old Russian: J. Dyneley Prince, professor of Slavonic languages, Columbia University.

Friday Evening, April 25

Reception from eight to eleven o'clock in the hall of the Historical Society of Pennsylvania,

southwest corner of Locust and Thirteenth Streets, at 8.30 o'clock.

Arthur Gordon Webster, Sc.D., LL.D., professor of physics, Clark University, Worcester, spoke on the "Recent applications of physics in warfare" (illustrated).

Saturday, April 26,

EXECUTIVE SESSION—9.30 O'CLOCK

Special business—Action upon the proposed amendments to the laws.

Stated business—Candidates for membership balloted for, with the result that the following new members were declared elected: Robert Grant Aitken, Sc.D., Mount Hamilton, Calif.; Joseph Charles Arthur, Sc.D., Lafayette, Ind.; Edward W. Berry, Baltimore; James Henry Breasted, A.M., Ph.D., Chicago; Ulric Dahlgren, M.S., Princeton; William Curtis Farabee, A.M., Ph.D., Philadelphia; John Huston Finley, LL.D., Albany, N. Y.; Stephen Alfred Forbes, Ph.D., LL.D., Urbana, Ill.; Chevalier Jackson, M.D., Philadelphia; Dayton C. Miller, A.M., D.Sc., Cleveland; George D. Rosengarten, Ph.D., Philadelphia; Albert Sauveur, S.B., Cambridge, Mass.; William Albert Setchell, A.M., Ph.D., Berkeley, Calif.; Julius O. Stieglitz, Ph.D., D.Sc., Chicago; Ambrose Swasey, Sc.D., D.E., Cleveland.

10 O'CLOCK

Hampton L. Carson, M.A., LL.D., vice-president, in the chair

Artificial formations resembling lunar craters: CAPTAIN HERBERT E. IVES, of Philadelphia.

The meteorological service of the Signal Corps in the war: ROBERT A. MILLIKAN, professor of physics, University of Chicago.

Detection of submarines (illustrated): HARVEY CORNELIUS HAYES, Naval Experiment Station, New London. (Introduced by Professor John A. Miller.)

This paper discussed various possible methods. The most effective one resulted from the development of a system of multiple sound sensitive receivers mounted in such a way as to transmit to both ears of the observer a cumulative or summational impulse which becomes a maximum when the instrument is properly directed, thus showing the direction of the submarine. It is clear that such an instrument would be valuable in peace times also in indicating the presence and direction of vessels in a fog.

Errors induced in bullets by defects in their manufacture: ERNEST W. BROWN, professor of mathematics, Yale University.

Sound and flash ranging: AUGUSTUS TROWBRIDGE, professor of physics, Princeton University, and late Lieutenant Colonel Engineers, of General Pershing's staff and in technical charge of the ranging service in the A. E. F.

The work of the Ballistic Institute of Clark University: A. G. WEBSTER, professor of physics, Clark University, Worcester, Mass.

Alternating-current planevector potentiometer measurements at telephonic frequencies (illustrated): A. E. KENNELLY, director, Research Division, Electrical Engineering Department, Massachusetts Institute of Technology, Cambridge, and EDY VELANDER.

The genesis of petroleum as shown by its nitrogen constituents: CHARLES F. MABERY, emeritus professor of chemistry, Case School of Applied Science, Cleveland.

Since so far as known complex nitrogen bases are produced in nature only through the agency of vegetable or animal life the universal presence of these bases in petroleum seems to be convincing evidence as to its origin. In most of the denser varieties these bases have been detected, in California and Russian petroleum in considerable amounts. In the present paper results are presented which show that the same or similar bases are generally present in the lighter varieties of the eastern fields—Pennsylvania, West Virginia and the Berea Grit of southern Ohio. I procured authentic specimens from these fields and find that they all contain from one part in 10,000 to one part in 20,000. A special method of analysis had to be devised to determine such minute proportions of nitrogen, a combination of the Dumas method for nitrogen and the oxygen method for carbon and hydrogen. Briefly described, the combustion was made in a glass tube one half filled with copper oxide, and in the vacant space the oil was placed in a boat with an oxidized copper roll behind and next behind a large boat containing potassium chlorate. In a second furnace was placed a steel tube filled with copper oxide, and heated to full redness to oxidize completely the hydrocarbons. Tight joins were made with castor oil seals and with a special form of rubber tube also luted with castor oil. Nitrogen was sufficiently removed by CO_2 from a rear generator containing several pounds sodium bicarbonate and repeated evacuations with a power pump extending through several days. The paper gives the results of analysis

in a table and in another table the history of the samples.

Graphic representations of functions of the nth degree: FRANCIS E. NIPHER, professor emeritus of physics, Washington University, St. Louis.

Glimpses of the near east during the war: A. V. W. JACKSON, professor of Indo-Iranian languages, Columbia University.

The empire of Amurru: A. T. CLAY, professor of Assyriology and Babylonian literature, Yale University.

The science of stealing (steyacastra) in ancient India: MAURICE BLOOMFIELD, professor of Sanskrit, Johns Hopkins University.

The crib of Christ: PAUL HAUPT, professor of Semitic languages, Johns Hopkins University.

The word translated "manger" in Luke II. 7, denotes one of the arched and open recesses in front of the travelers' chambers along the interior court of a caravansary. Shakespeare uses "crib" in the sense of "small chamber." The inn in which Jesus is said to have been born may be the hostelry mentioned in Jerem. XII. 17 where the Revised Version gives in the margin: the lodging-place of Chimham. The caravansary may have been founded by Chimham, the son of Barzillai, who followed David to Jerusalem (II. Sam. XIX. 38). The name Bethlehem is derived from this ancient inn near the town, on the road from Jerusalem to Hebron. Bethlehem does not mean House of Bread, but House of Bait, *i. e.*, halt for refreshment.

The atonement idea among the ancient Semites: EDWARD CHIERA, instructor in Assyriology, University of Pennsylvania. (Introduced by Professor Morris Jastrow, Jr.)

Saturday, April 26, 2 o'clock

Arthur A. Noyes, Sc.D., LL.D., vice-president, in the chair

Symposium on Chemical Warfare—Historical introduction: COLONEL MARSTON T. BOGERT, Chemical Warfare Service, U. S. A.

The speaker gave a brief review of the history of chemical warfare both before and during the war, pointing out the high spots in the field and including also an outline of the organization of the Chemical Warfare Service of the United States Army and its activities.

Chemical warfare and research: COLONEL GEORGE A. BURRELL, Chemical Warfare Service, U. S. A. (Introduced by Colonel Bogert.)

Chemical warfare and manufacturing development: COLONEL FRANK M. DORSEY, Chemical Warfare Service, U. S. A. (Introduced by Mr. A. A. Blair.)

Production of chemical warfare munitions (illustrated): COLONEL WILLIAM H. WALKER, Chemical Warfare Service, U. S. A. (Introduced by Professor H. F. Keller.)

Production of chemical warfare munitions (illustrated): COLONEL BRADLEY DEWEY, Chemical Warfare Service, U. S. A. (Introduced by Dr. Philip B. Hawk.)

This paper discussed the following points: (1) The problem of making over 5,600,000 gas masks in eight months; 5,000,000 of these going overseas together with 2,800,000 extra canisters. (2) The history of starting a government-owned factory at Long Island City, which on the day of the armistice covered a million square feet of floor space and had 12,500 employees. (3) The problem of manufacturing the chemicals for gas masks, with mention of the fact that 50 tons a day were necessary and with emphasis of the part played by the peach pit campaign in furnishing some of the 400 tons a day of coconut shells and peach pits necessary to produce the gas mask charcoal. (4) Mention of the manufacture of one half million horse masks and miscellaneous gas defense protective apparatus, other than horse masks. (5) A description with lantern slides showing some of the work done by the Field Testing Section, digging trenches and fighting miniature battles in gas in order to work out the characteristics of gas masks.

The usual banquet on Saturday evening was given at the Bellevue Stratford with about seventy-five members and guests present. Toasts were responded to by Honorable George Gray, Professor E. G. Conklin, Professor J. W. Bright and Dr. J. W. Holland.

ARTHUR W. GOODSPEED

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE SCIENTIFIC SPIRIT[1]

THE scientific spirit, while not easy to define, is a reality, differing from the artist spirit in some important elements and differing also from the usual spirit in philosophy. William James, to be sure, made philosophy almost an experimental science, and religion may be and is so treated by a few. Perhaps as good a concise statement of the scientific spirit as we have is from the pen of Paul of Tarsus, who wrote: "Prove all things and hold fast that which is good." I wish to discuss this injunction with you for a few minutes, to direct your attention to a number of conceptions and practises built into our present social system which do not successfully endure such scrutiny as Paul suggested, and finally we will refer briefly to the scientific spirit in relation to some deep issues of the war and some profound problems of the post-war period.

Science versus tradition, experiment versus conformity to convention, scrutiny versus blind faith, reason versus custom. We are all creatures of habit, mental and physical. Indeed custom lies at the root of our whole social system, and necessarily so. Community life is dependent upon the dominance of social custom. A group of individuals each of whom went his own independent and unpredictable way would not form a real community. The conservative tendency in men, the habit of thinking and doing as their fathers thought and did, is essential in enabling them to live and work together as a cooperating society rather than be a mass of contending rival units. And one of the chief services this conservatism renders to human society lies in the difficulty which it presents to the

[1] Address by the president of the Ohio Academy of Science, at the annual meeting of the academy, in Columbus, Ohio, May 29, 1919.

entrance and adoption of new and strange conceptions or lines of conduct. The new, whether new in idea or merely new in emphasis, must fight and must find itself and prove itself in this initial struggle, before it can prevail. This struggle for existence among social ideas is the scientific experimental laboratory for society, and the whole social experimental method is dependent upon the natural human conservatism which causes and makes intense this struggle through which social ideas must pass to be accepted.

But I wish to emphasize this evening another aspect of the matter, the value of having new conceptions to test, and the importance of an attitude of impersonal search for the truth, rather than a struggle for personal advantage. "Ye shall know the truth and the truth shall make you free," free from subservience to unwarranted custom and, especially, free from self-seeking. Is not the scientific spirit epitomized in each of these two injunctions, which are but different statements of the same ideal —"Prove all things and hold fast that which is good," "Know the truth and the truth shall make you free"? The ideal, the habit, of impersonal search for the truth is one of two essential foundations of worthy society. The other fundamental social ideal is more explicitly stated by the great Jewish teacher— "As ye would that men should do to you, do ye even so to them." Given the natural quality of conservatism in man, then the essentials to sound society are untrammelled thinking and unselfish action.

Now both of these, untrammelled thinking and unselfish action, are part and parcel of the scientific spirit. In thought, truth for the joy of the knowing; in action, loyalty to truth so far as discerned. Are not these the core of the true spirit of science?

Most social customs have had a long development. Nearly every one has had an embryological and larval and adolescent history and it is of keen interest to trace any such custom back through its successive periods to the germ from which it started. During the period of development and growth the custom is built into society and becomes almost a part of its organization. Changing it is like changing a physiological habit, removing it involves a surgical operation. It is not difficult to understand that such customs have the strongest hold upon society and upon most individual men.

Yet it is surprisingly easy, if one cultivates the habit, to adopt a detached attitude and to view these customs as scientific phenomena to be observed and appraised without prejudice. It is still more surprising to see how many of our important social customs, when so viewed, are without scientific warrant, are indeed socially absurd. Let us instance a few such mistaken social customs in illustration.

One of the most absurd of social economic conventions is the adoption of a single metal as a MEDIUM OF EXCHANGE, though this constantly fluctuates in value like any other product. An essential feature in a good medium of exchange is, of course, stability in value, so that debts will be paid in dollars of the same worth as the dollars or other consideration received when the debt was contracted.[2] Society has made no attempt to secure such an unfluctuating medium, but has merely chosen the most precious metal which is found in sufficient abundance. Irving Fisher is now proposing that the government charge a varying seigniorage for the coinage of gold, less when gold is dear, more when it is cheap, and thus keep the gold dollar of constant value. This seems to be along the right line, for the usability of gold as a medium of exchange depends upon both its intrinsic value and its monetization, the latter giving it the necessary fluidity and so affecting its value apart from normal supply and demand. Fisher proposes to establish the amount of seignorage by comparing the value of gold from time to time with the then value of a composite group of natural products—grains, coal, metals, etc. There are but two sources of wealth, natural resources on the one hand, and human labor on the other. The medium of exchange should be of constant value with

[2] Investments as well as debts should, of course, be here included.

relation to both of these, and grains coal, metals etc., upon the market, are a combination of natural resources and human labor. Of course ultimately the medium of exchange should be determined and regulated internationally, not nationally.

In merely taking our most valuable abundant metal as a medium of exchange, as now, we are following without effort an old custom and are making no attempt to have our medium of exchange conform to the needs of society. Instead of attempting to solve the problem, we are accepting failure, and almost all men, because accustomed to this unsatisfactory medium, accept it without question. Conservatism versus reason. The blunder involved is one of the serious financial mistakes in our socio-economic system. We can all realize in these days the difficulties that come when the value of the dollar and the value of other things part company, and the purchasing power of our incomes is decreased by a third or more.

Another, more serious, economic error is the permitting of PRIVATE OWNERSHIP OF LAND AND OF NATURAL RESOURCES. There are two sources of wealth, natural resources and human labor, and the labor is wholly dependent upon the natural resources and can not exist without them. The foundation of life is therefore the Earth and its products. The absurdity of our present system is seen in the fact that it allows a Super-Rockefeller to own the whole Earth and in consequence to own its inhabitants, involving thus a super-form of slavery. There could be no greater economic blunder than this, for it involves the very foundation of human society. Fortunately the facts are recognized by some of our keener economists and somewhat hopeful attempts are being made to withdraw from this absurd plan of economic organization and get upon a basis that will recognize that the earth belongs to all men and must be preserved to them and for them. The fact that withdrawal from a false system involves the greatest difficulties is no sufficient reason for giving up the problem.

Our economic life has become so complex that INDIVIDUALISM in large scale INDUSTRY is no longer reasonable. Over 90 per cent. of all men who engage in business fail at some time in their lives. The great percentage of failures shows the enormous risks in industry. Therefore the rewards to successful capital must be made proportionally great. Society pays dearly in the first place for the failures, and then she has to pay unreasonably for the successes. Capital can not be led to take the great risks without inducements adequate to the risks. The present industrial system is clearly unsatisfactory. Society must find some way to relieve industry from these great risks and must then organize the rewards upon a more reasonable basis. There are two most fundamental changes imperatively demanded in our economic system: the first is public control of land and natural resources for the benefit of all mankind; the second is such organization of essential industry as will allow society itself to carry at least the major part of the risks of failure. In this way the risk of failure would be greatly decreased, also the cost of industry, in the form of the returns to the successful, would be greatly reduced, and (probably most valuable of all) there would result a better balanced human community with less economic contrast between the extremes. It is futile to attempt to dodge solving this difficult problem. We must come to it eventually. Why not approach it now?

The real problem here is to introduce into all social effort the same spirit of putting the job through for the sake of the country and the world, which we have seen so finely exemplified in the war effort of our soldiers and of our people at home. Not only we, but all of our allies, have thrilled with this spirit of devotion to country and to the service of all the world. The perpetuation and strengthening of this same spirit and its introduction into all the life of the people is the real goal in the social reorganization which we seek. Under the present system of industry labor is prone to feel it is working not for the general good, but for the profits of capital. A spirit of selfishness and unwholesome rivalry is thus encouraged. Society can never ap-

proach its true goal until conditions are so changed that the very social organization shall itself encourage the spirit of altruistic service. Our soldiers, as they went over the top, were very conscious of ravished Belgium, and even their meaner tasks were dignified by a realization of the importance and necessity of the great job of which these tasks were a part. Putting the job through for the sake of the country and of all the world, that should be the general spirit. The socialistic scheme of eliminating private profit from industry would put industry on a patriotic basis and the spirit with which our soldiers fought and our people labored and saved might well be paralleled by the spirit in industry. Let our progressive reorganization of society keep in line with this goal, each step bringing us a bit nearer to its realization. The problem, however, is no simple one, for there must be no discouragement to individual initiative.

A far less fundamental, yet a huge economic blunder is seen in the adoption of fire insurance as a substitute for FIRE PREVENTION. I have no quarrel with fire insurance as such, but we are strangely blind when we let the partial protection of the individual through fire insurance cause us to feel such security that we continue to allow the commonwealth to suffer its huge fire loss which in America amounts annually to about two thirds the cost of building the Panama Canal. In all the nations of the world combined there has never been spent all told a hundred million dollars, or anything near that sum, in the study of the problem of fire prevention, though in the United States of America alone the annual loss by fire is from two and one half to three times that amount. Of course with sufficient expert study it would be easy to devise simple and inexpensive methods of protecting all buildings against fire. Wooden buildings, or even those with paper partitions, as in the city of Tokyo, could readily be so protected that a fire should not pass beyond the room in which it originated. Forest and prairie fires might be somewhat more difficult to prevent.

Little that is really worth notice is now being done toward remedying this great economic blunder and no one is interested in any sufficiently broad way in its discussion. A government bureau, with many millions at its disposal, should be studying the problem. But scientific study is one of the most difficult things to secure. It is comparatively easy to persuade men to act, however ignorant they may be of the data involved in their field of action, but to get men to consent to large expenditure for study of a problem is a matter of the greatest difficulty. The scientific ideal of search for data before acting does not sufficiently appeal to the average man.

Again we can instance as unwarranted the allowing of private rivalries in a matter so vital as TRANSPORTATION, whether of persons, goods or messages. Society is so dependent upon transportation that its interest are paramount. In contrast, however, we have most of us known of railways which inconvenience public business to injure their rivals or to promote their own interests.

In our country we have a conspicuous instance of economic absurdity in our system of TAXATION. In ancient days it was customary in many countries to "farm out" the taxes to private collectors, making them pay a given sum into the treasury and permitting them to keep for themselves whatever amount beyond this they could succeed in raising. But to America alone, among modern occidental nations, belongs the distinction of continuing this ancient system to the present day. Our national government exposes the American citizen, without protection, to the brigandage of forty-eight separate states, each seeking to fill its own coffers from his pocket, and oblivious of the extent to which other states may already have plundered him. Our present system puts really irresistible pressure upon each state to offer inducements to investment of the capital of its citizens at home and to penalize by taxation its investment outside the borders of the state. I used to have stock in an Illinois corporation which owned the control of a business in Wisconsin, of another in Ohio and of still another in Tennessee, and each of these subsidiary com-

panies had property in other states than that in which its works were located, these properties all being reckoned in determining the market value of the stocks of the parent and of the subsidiary companies. As a resident of Ohio I paid Ohio taxes on all of these properties, either directly, or as a part of the stock value. As a stockholder of the parent Illinois company, I paid, through them, Illinois taxes on all the properties of all the companies. I also paid similar Wisconsin taxes on all the property of the Wisconsin company including taxes on their property in other states. Through them I also paid full taxes in other states on all their real property in those states. I paid Ohio taxes on all the property of the Ohio company, wherever located, and also taxes in other states on their property in those states. Similarly I paid taxes in Tennessee on all the property of the Tennessee company, wherever located, and I also paid taxes in several other states on property of the Tennessee company in those states. Full local taxes were paid on all realty in its own locality and, through the tax on corporation stocks, one to three additional taxes were collected upon most of this property. Many pieces of property paid four taxes on full valuation. And this is comparatively a simple instance. American citizenship, different from citizenship in any other western nation, does not protect a man from exploitation by the irresponsible agents to whom the taxing power is farmed out.

Of course the determination of the principles of taxation should be national, it being left to the several states and to the lesser community units to determine only the amount of money to be raised. There is widespread complaint of the injustice of our taxation system, and many are endeavoring through action in the several states to ameliorate the conditions, but no one is effectively attacking the problem in the only place where its possible solution lies, namely, in connection with national control. Of course this grotesque feature of our politico-economic system should promptly be removed.

The allowing of traffic in ALCOHOLIC BEVERAGES is an economic and social blunder which happily is about to be remedied.

The use of WAR as a method of settling international rivalries and disputes we hope may be abandoned as a result of education through the great war just closed. War, the result of allowing international relations to be those of unrestricted rivalry rather than of cooperation, is of course characteristic of an early stage of development of human society. As the principle of integration comes to have fuller sway and a society of nations is established with safeguards and sanctions similar to those prevailing within the several nations, war will diappear except in the form of riot against law. The most ancient human social unit is probably the family. There have emerged the clan, the tribe, the state, and now perhaps we see the travail of the birth of the world community from which war shall be banished.

A false and unsocial principle hitherto accepted is that the possession of wealth excuses a man in some degree from SOCIAL SERVICE. An emphasized form of this same principle makes the possession of wealth entitle a man to direct the labor of other men into channels promotive of his selfish interests irrespective of the relation of this form of labor to the general welfare. Closely related is the emphasis in our legal system upon property rights and interests in contradistinction to what we may call manhood rights and interests. There are those who, with Professor Carver of Harvard, claim that social principles can be given adequate expression in terms of economics, but I believe this to be false. Economics deals with property and with labor with reference to property, all of which, as I believe, is wholly subsidiary to manhood considerations. Sociology is not only the larger field. It is more fundamental. It is not unusual to hear economics referred to as a science and sociology as an unorganized and unscientific mass of data and ideas. I'm afraid it is largely a case of the pot calling the kettle black. It is remarkable how many "established principles" of economics are not true. Sociology is the larger field, yet each is so large and so com-

plicated and involved that conclusions of much breadth in either field are unreliable when they pass beyond a few major underlying principles. The mass of detail in each field is too great for us to have much confidence that we have successfully digested it.

There are some of us who are beginning to feel that the supreme blunder of human society is in allowing UNRESTRICTED BREEDING under conditions that even encourage, in fact, a relatively large production of the less desirable types of men. But I do not care to discuss eugenics at this time.

Is this list of social blunders sufficient to emphasize my point of the need for free-thinking men who approach a subject without undue bias, gathering and weighing data impartially, testing all things in the search for the truth and holding fast that which is shown to be good, good for society, without too much thought of its relation to what may be their own selfish interests? Is it not evident that "Denmark" is not the only state in which there is much of unsoundness? Could any mental attitude be more unjustified than that which led a certain philosopher[3] to say—"Whatever is is right"? It would be nearer true to say—"Whatever is is wrong: the question is how wrong?"

The study of science, if properly conducted, and the study of other subjects by the scientific method, tend to free the mind from tradition and to lead one out into larger outlooks. One general type of scientific study, especially, seems to have this liberating, enlarging effect. I mean study in those fields of science in which the outworking from cause to effect occupies such immense, unthinkable stretches of time that the element of time loses its interest. Evolutionary studies, whether of living things or of Earth forms or stellar systems, involve such unthinkable lapses of time that the student neglects the time element and focuses his attention rather on the outworking of the principles involved. The economist or sociologist thinks usually in years or decades. The student of organic evolution, the geologist, the astronomer, rarely thinks in terms of time and when he does his time is measured in æons not in years. His thought centers in the outworking of the influences in operation and not upon the time it takes them to reach their goal. The oppositions to be overcome, the delays to be met, by these cosmic forces mean little or nothing. The student in these subjects comes to despise time as an element in his problems. The field is too vast for time to be of any interest. It is the principles involved, the outworking relations between phenomena, that command his thought.

[3] Pope.

Might it not be worth while to think occasionally of our economic and social problems in this same spirit, omitting time, ignoring the oppositions to be overcome, and dwelling rather upon the underlying truths and their ultimate, logical, necessary outworking?[4] Truth is mighty and will prevail. When once it stands revealed, nothing can permanently stay its progress. Human prejudice and conservatism can only delay for a period, but not indefinitely. Why not do some of our social thinking in terms not of years or of decades but rather in terms of decades of centuries, freeing our minds from the shackles of the immediate with its confusion and its obstacles, and rising to the vision of things as they are and their necessary ultimate outworking? Let truth emancipate us with her free spirit, giving us to see beyond the present detail. In my twenty years of teaching I have watched many a student of organic evolution catching this broader view and learning, in his attitude to life and its problems, not to dwell wholly amid the details of the present but to appreciate as well something of the timeless march of the principles of truth.

If one has caught this idea and has spent occasional periods in the endeavor to grasp not the mass of detail but the more fundamental relations, he will find, I think, that his mind has been somewhat freed from its traditionalism. He will thereafter be a bit

[4] I would not imply that thinking of social problems from the timeless viewpoint should at all replace the more customary study of these problems. I urge it only as a supplement to such study.

more open-minded toward unfamiliar ideas. His natural reaction may even change from one of initial opposition to the strange, to one of interest and inquiry. Labels may lose some of their blighting command over his thought and he may lose his fear of such words as Democrat, Republican, heretic, agnostic, socialist, capitalist, conservative,[5] radical. The beginnings of freedom may be his.

Was there ever a time when there was more need than now for the unprejudiced spirit which shall receive with open inquiring mind the new ideas that are coming to the fore, and was there ever greater need for an impersonal unselfish spirit than in the social developments of the near future?

I fully believe that the organization of society is to be decidedly changed, that in our legal systems manhood rights and interests are to receive more emphasis in comparison with the rights and interests of property, and that selfish use of power by state or individual will be frowned upon and effectively restrained. The fight against slavery is won the world round. The fight against the special privilege of birth is already won in most countries, and through the aid of the great war will soon be won in all lands. The fight against the special and undue privilege of wealth is now fairly on and it will be a harder fight than either of the others and more searching in its test of the strength of our social bonds.

Any attempt to suppress the movement toward social rebuilding I believe not only to be foredoomed to failure in the end, but also to be extremely dangerous. Sitting on the lid beneath which is seething a deep discontent will merely delay action until the forces become beyond control, and will result in a dire explosion. Bolshevism and I. W. W. outrage will result and the civilization of the world will go into the melting pot. The great movement of the mass of mankind, the world round, toward reorganization of society upon a basis giving to all men a more just share in the organization, the control and the rewards of industry and in the joys of life is to-day so powerful and the stimulus from the great war is so intense that all nations will be stirred to the depths. Who are we in America that we should escape our share of the world travail in the birth of the new order?

Traditional conceptions will not help us here. Self interest is no safe guide. Indeed our greatest dangers are from prejudice and selfishness. The American labor unions and organized capital must change their intensely selfish pre-war spirit if they are to cooperate successfully in the work of reconstruction. Collective bargaining for the adjustment of the interests of organized labor and capital, with no representation of and little concern for the interests of the general public, will not take us far toward the true goal.[6] Similarly the general prejudice of organized capital against socialistic tendencies is a hindrance to its rendering effective service in the solution of the problems. Labor's present feeling that it is working in considerable measure to increase the already undue profits of the capitalist develops an unsocial spirit, and so long as the present plan of organization of industry persists it is difficult to see how a more wholesome spirit can be engendered and fostered. The fine war service of both labor and capital shows a capacity for unselfish cooperation, if we can but reorganize society in such a way that all may feel that they are working directly for the common good and are getting a fair share of the rewards of their labor. The English labor party and such Americans as Brandeis, Wilson and Baker have their faces set toward the new day and are both open-minded and broad-minded. In such as they, not in the present spirit of American labor unions, lies chief hope of leadership. If instead of opposition to the seething social forces we may have sympathetic guidance, there is hope of progress without

[5] It is a question whether heretic or conservative is the label more feared among American scientists. Conservatism is out of style and is itself almost heretical.

[6] I recognize, of course, the moderation and large-mindedness of the university professors' union and of some, at least, of the railway men's unions and possibly of some others.

cataclysmic disaster. The tremendous energy of the forces now stirring in society is too valuable to be wasted even if we could suppress it. It should be guided into the performance of valuable work. Led off through the proper channels and connected with the reorganized machinery of society it could do great things. But it must be led to service of society as a whole and not to service of any privileged class, proletariat, bourgeoisie, or aristocracy.

Class prejudice, class rivalries, class hatreds, any organized or individual self-seeking at the expense of others, must be fought wherever found and the open unselfish mind promoted. In leading and in upholding the hands of the leaders the men of true scientific spirit will effectively serve. They will be the leaven, helping the people to understand and accept the new order. The road to the new and better order is through intelligence and altruism, through appreciation of and devotion to the truth, that is through the scientific spirit. Does this seem a tame conclusion? It is old fashioned, as old fashioned as the man of Nazareth who is still unsurpassed in clear vision into the heart of the truths underlying human relations and in unselfish devotion to the truth as seen.

Maynard M. Metcalf
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Oberlin, Ohio

SCIENTIFIC EVENTS

INTERNATIONAL COOPERATION IN MEDICINE

According to the London *Times* a very large sum of money has been promised to found what will amount to a headquarters of the American Medical Association in England. The headquarters are to consist of a hospital, a library, lecture theaters, and demonstration rooms, reading rooms, and so forth. American doctors will thus possess a rallying point when visiting London, and the spirit of English medicine will be made free to them in a manner impossible by any other means.

It is understood that Lord Reading has accepted the presidency of the scheme and that Mr. Taft is much interested in it. The names of Messrs. Newton Crane and Van Duzen are also associated with the work, while the secretary of the American College of Surgeons, Dr. Franklin Martin, of Chicago, has taken a prominent part in furthering it. The new hospital may, it is hoped in some quarters, become a kind of Rockefeller Institute in London. British medical men are anxious to give all the help they can.

The forthcoming general meeting of the American Medical Association at Atlantic City is likely to be attended by, among others, Sir Arbuthnot Lane and, it is hoped, Sir Bertrand Dawson, who will thus help further to cement the friendship which now exists between the profession in the two countries.

Efforts are also being made in Paris to increase the usefulness and importance of the British Hospital there. This hospital, the Hertford, is rather small and the site has certain drawbacks. A scheme recently put forward would transfer it to a new site in the Bois de Boulogne and would considerably enlarge its scope. Speaking at an informal gathering recently, Dr. Monod, a distinguished French doctor, declared that British doctors would receive the warmest welcome in his country, and expressed the hope that French doctors would be encouraged to go to England to study. This gathering, which was presided over by Sir Bertrand Dawson, included some of the most outstanding physicians, surgeons and medical officers in the British and Colonial professions.

THE TOTAL ECLIPSE OF THE SUN

Professor Henry Norris Russell, of Princeton University, writes in the *Scientific American* as follows:

> The present month is notable for the occurrence of a great eclipse, which happens on the 29th, and affords the longest view of the surroundings of the sun, while its own disk is hidden, which has been possible for many years.
>
> At the time of this eclipse the moon is within a day of perigee, and unusually near the earth—her distance being a little less than 224,000 miles. In consequence her tapering shadow is still nearly 150 miles in diameter where it reaches the earth's surface, and observers situated within the belt, about 8,000 miles in length, over which this shadow sweeps as it crosses the earth's disk, will see a

total eclipse of unusual duration, which, at maximum, may amount to six minutes and fifty seconds.

The eclipse track is rather unfortunately situated. Beginning in the Pacific Ocean, just off the coast of Peru, it sweeps across South America, traversing the Bolivian Mountains, the forests of Brazil, and the higher lands of the eastern coast. Then it crosses the Atlantic, almost along the equator, just grazes the southern coast of the great western projection of Africa, passes temporarily out to sea again, and crosses the main part of the dark continent by way of the Congo basin and Lake Tanganyika—finally leaving the earth's surface at a point in the Indian Ocean not far from the African coast.

The region within which a partial eclipse is visible extends far northward and southward, including practically all of South America except the extreme southern trip, and all of Africa except the Mediterranean coast. The region where totality is longest lies in the Atlantic, and the maximum duration of eclipse observable from land stations is about four minutes, which is reached on the east coast of South America and the west coast of Africa. There is, to be sure, one small island in the Atlantic, lying almost in the central line of totality, where the eclipse lasts fully six minutes; but as this spot, known as St. Paul's Rocks, consists of a few jagged rocks rising to a height of 60 feet from deep water, with no anchorage and no fresh water, it is hardly an inviting station for even the hardiest astronomer, in spite of the fact that certain optimistic souls have nominated it as a way station for transatlantic airplane flights.

The climatic conditions along most of the track are unfavorable—the best chances of fine weather being on the high lands back of the eastern coast of Brazil, and in central Africa above Tanganyika. On account of the remoteness of these stations, and of the disorganization resulting from the war, few expeditions appear to be projected to view the eclipse. One English and one or two American parties, however, are likely to make the journey.

MAPPING FROM THE AIR

REQUESTS made to the United States Geological Survey, Department of the Interior, for information concerning the possibilities of photographic surveying from airplanes or other aircraft have recently become so numerous that it is deemed necessary to issue a statement on this subject. For two years the United States Geological Survey, which prepares and publishes more maps than any other organization in the world, has devoted much time and labor to the study of problems to be solved in photo-aerial surveying. The camera has long been used in surveys on the ground, and the Geological Survey has been making studies to determine the best methods of using it in aerial work. Before the war the panoramic camera was employed by the Geological Survey for mapping in Alaska, and it had been widely used for photographic surveying in Canada and in Europe. Aerial photographic surveying involves no new principles, yet it differs essentially from photographic surveying on the ground, for the line of view from a camera in a balloon or an airplane is vertical, not horizontal. A complete statement of the Geological Survey's investigations in photographic mapping from the air will later be prepared for publication.

The problem of photographic surveying from the air is dominantly an engineering problem. Photographic technique is of course an essential part of the work, but it is a subordinate part, for the best photographs are valueless as map-making material unless they are accompanied by the requisite engineering data. Projections, adjustments, and other details of map-making technique are as necessary in photo-aerial surveying as in other surveying, and all map-making work should therefore be the work of experienced engineers.

Photographic mapping from aircraft is entirely practicable but it has not yet been brought to the point where it can supersede ground surveying. The science of cartography will no doubt be greatly advanced when the aerial method is perfected, but fundamental problems remain to be solved, and this fact should be recognized and all possible energy should be devoted to the solution of those problems. It is hoped that solutions of the essential problems in photo-aerial surveying will soon be obtained, and that this method will be put to practical use in map-making.

FIFTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

THE Fifth Annual National Exposition of Chemical Industries will be held this year in

Chicago at the Coliseum and First Regiment Armory during the week of September 22, and as usual there will be a number of society meetings held jointly with it.

The *Journal of Industrial and Engineering Chemistry* states that the movement to Chicago was decided unanimously last September at a meeting of the advisory committee of the exposition with the managers of the exposition for two reasons: The U. S. Army commandeered the Grand Central Palace immediately upon the close of the last exposition, to be converted into a receiving hospital, use for which has now, happily, nearly ceased. The Chicago Section of the American Chemical Society had been active in its interest in the exposition and was keenly interested in having it held in the city of Chicago; the Association of Commerce felt a keen interest in welcoming the exposition; it was the thought of all that the exposition would stimulate development along chemical lines in the Chicago district and the adjoining states.

The Advisory Committee of the Exposition consists of:

Charles H. Herty, *Chairman,* editor, *Journal of Industrial and Engineering Chemistry.*
Raymond F. Bacon, director, Mellon Institute.
L. H. Baekeland, member, Naval Consulting Board.
W. D. Bancroft, president, American Electrochemical Society.
Henry B. Faber, Industrial Filtration Corporation.
Ellwood Hendrick, president, The Chemists' Club.
Bernhard C. Hesse, General Chemical Company.
A. D. Little, president, Arthur D. Little, Inc.
Wm. H. Nichols, president, American Chemical Society.
R. P. Perry, vice-president, The Barrett Company.
H. C. Parmelee, editor, *Chemical and Metallurgical Engineering.*
G. W. Thompson, president, American Institute of Chemical Engineers.
T. B. Wagner, United States Food Products Corporation.
M. C. Whitaker, president, United States Industrial Alcohol Co.
Charles F. Roth.
Fred W. Payne.

There is also added a special Chicago advisory committee consisting of L. V. Redman, W. D. Richardson, A. V. H. Mory, Carl S. Minor, F. W. Willard and Wm. Hoskins. The managers, as in the past, are Charles F. Roth and Fred W. Payne, and the general office is at 417 South Dearborn St., Chicago, Ill.

When the move to Chicago was first planned it was decided to use the largest available exposition building there, the Coliseum, which is conveniently located for the business, hotel, residence and industrial centers of the city. It soon developed that the space in the building was inadequate and shortly after the signing of the armistice when government property again became accessible, the management made arrangements to engage the First Regiment Armory for exhibits and meetings of some of the societies. The armory faces the next parallel street, which is Michigan Boulevard, and is separated from the Coliseum by only a narrow alleyway. The managers report that a considerable part of this space is already engaged, much of it by Chicago concerns, promising a creditable showing for Chicago industrial progressives.

The number of exhibitors is already larger than at the same time last year and includes many new companies who have not formerly exhibited. There are also on the list the names of regular exhibitors who have become inseparably connected with the exposition and who have become established as the bulwarks of the American chemical industry.

Of the meetings to be held in connection with the exposition a program is in preparation which includes the general meetings of the American Electrochemical Society, the American Institute of Mining Engineers and the American Ceramic Society. The Technical Association of the Pulp and Paper Industry is planning to meet with the exposition in several technical sessions. The Chicago Section of the American Chemical Society will have headquarters at the exposition

where it is probable that a meeting will be held. There are already indications that these meetings will be interesting ones. The Mining Institute is arranging a pyrometry symposium which will consider such questions as: Methods of pyrometry, industrial pyrometry, pyrometry and its relation to science. Special stress will also be laid upon the iron and steel industry by the institute. The American Electrochemical Society is planning an interesting program; so, too, is the Ceramic Society.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM GILSON FARLOW, professor of cryptogamic botany in Harvard University, died at his home in Cambridge on the third instant, in the seventy-fifth year of his age.

THE American Medical Association is meeting this week in Atlantic City under the presidency of Dr. Alexander Lambert, of New York City. The Congress of American Physicians and Surgeons meets in the same place next week under the presidency of Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research.

PROFESSOR THOMAS C. CHAMBERLIN, head of the department of geology and paleontology of the University of Chicago, retires at the end of the present academic year.

THE French minister of education, acting on representations made by the Bureau of Longitudes, has named the following correspondents: George Ellery Hale, director of the observatory, Mt. Wilson, Calif.; William Wallace Campbell, director of the observatory, Mt. Hamilton, Calif.; William Snyder Eichelberger, director of the United States Naval Observatory, Washington, to replace Professor M. Foerster, disbarred from the list of correspondents as being a German subject; and Senator Righi, professor at the University of Bologna, Italy. The late Professor E. C. Pickering was for many years the only American correspondent of the Bureau of Longitudes.

SIR NAPIER SHAW has resumed the administrative duties of the directorship of the British Meteorological Office, from which he was relieved in May of last year by the appointment of Colonel H. G. Lyons to be acting director for the period of the war.

A COMMITTEE has been formed consisting of colleagues, students and friends of Professor Landouzy to secure funds by subscription with which to establish a Landouzy Museum at the Paris School of Medicine and to strike off a medal in his honor.

IN view of the retirement of Professor F. P. Dunnington, of the school of analytical and industrial chemistry of the University of Virginia, the following resolution has been passed by the visitors: "Resolved, that the rector and visitors of the University of Virginia accept the resignation of Professor Francis Perry Dunnington with very sincere acknowledgment of his long, capable and faithful service to the university. The rector and visitors assure him of their confidence and good will, and wish for him a long life of continued usefulness in his career."

DR. J. C. MARTIN, assistant curator in the division of economic geology of the National Museum, has accepted a position with the U. S. Geological Survey. Mr. Earl V. Shannon has been appointed assistant curator in the department of geology of the museum.

LIEUTENANT COLONEL ALFRED H. BROOKS, geologist in charge of Alaskan Mineral Resources, U. S. Geological Survey, who has been with the American Army in France since the summer of 1917, has returned to Washington and is again taking up his geological work with the survey.

DR. ARTHUR W. DOX, after nineteen months' military service as captain in the Sanitary Corps, has returned to his former position as chief of the chemistry section of the Iowa Agricultural Experiment Station.

DR. DAVID KLEIN, formerly state chemist of Illinois, who has been serving in the Sanitary Corps with the American Expeditionary Forces in France, has been promoted from the rank of captain to that of major. He will spend part of the summer in Serbia with the American Relief Administration. Major Klein has just been appointed associate pro-

fessor of chemical hygiene in the school of hygiene and public health of the Johns Hopkins University.

Major O. B. Zimmerman, formerly liaison officer between the Army Engineer Corps and the Bureau of Standards, has accepted a position with the International Harvester Company in Chicago.

Captain D. L. Williams, formerly of the department of chemistry of the College of the City of New York, who has been at the American University as executive officer, has been honorably discharged and will probably go into business.

E. O. Fippin, extension professor of soil technology at Cornell University, has secured a leave of absence for one year, during which time he will act as director of the Agricultural Bureau of the National Lime Producers Association.

Mr. Chester H. A. Hammill has resigned from the geological department of the Roxana Petroleum Company in order to undertake independent work at Dallas, Texas.

Mr. James M. Hill, Jr., is on leave of absence from the Geological Survey, engaged in prospecting for platinum in Colombia.

Dr. H. Foster Bain has resigned from the Bureau of Mines and will sail from Vancouver this month to continue his explorations in China for New York mining interests.

Dr. J. W. T. Duvel, who for many years was crop technologist in charge of grain standardization investigations, Bureau of Markets, U. S. Department of Agriculture, has resigned to accept a position with the United States Food Administration Grain Corporation, at 42 Broadway, New York. Dr. Duvel was loaned to the Grain Corporation during the latter part of the war and for six months previously he made an investigation of the wheat situation in Australia for the Bureau of Markets, U. S. Department of Agriculture, and for the U. S. Food Administration.

The Howard Taylor Ricketts Prize of two hundred and fifty dollars, awarded annually in May to the student showing the best ability in research work in bacteriology or pathology at the University of Chicago, has been divided between Mr. Frederick W. Mulsow and Mr. Emanuel B. Fink, both of whom are doctors of philosophy. The prize is given in memory of Professor Howard Taylor Ricketts, who died in Mexico from a contagion he was investigating.

Professor B. B. Boltwood, director of the Yale Chemical Laboratory, has addressed Sigma Xi of Brown University on "Radioactivity and its bearing on chemical theories."

Dr. John M. Dodson, dean of Rush Medical College, in affiliation with the University of Chicago, and chairman of the council on medical education of the American Medical Association, delivered the address at the commencement exercises of the medical department of the University of Texas.

At a meeting in Birmingham last week of representatives of the engineering profession and others, a provisional plan for celebrating the centenary of the death of James Watt was agreed upon. It includes the endowment of a chair of engineering at the university.

The ninth annual May lecture of the Institute of Metals, London, was delivered by Professor F. Soddy on "Radio-activity," on May 19.

The *Journal* of the American Medical Association states that to honor the memory of the eminent Spanish histologist, Achúcarro, whose untimely death was chronicled last year, his family has founded a prize of 1,000 pesetas to be awarded biannually for the best work that has been published in the four preceding years on normal or pathologic histology. The prize will be awarded alternately in Spain and abroad. In Spain it can be given for the best work on general biology or the total works of an author, as well as for work in histology. Abroad, the field is limited to histology of the nervous system. The board of awards consists of Professors Ramon y Cajal and L. Simarro, with the laymen, the marqués de Palomares and Severino Achúcarro. The prize is to be awarded this year to a Spanish writer.

The opening lecture of the graduate summer quarter in medical sciences at the University of Illinois, Chicago, Ill., will be de-

livered on Monday, June 9, by Michael F. Guyer, Ph.D., professor of zoology in the University of Wisconsin, on "The transmission of eye-defects induced in rabbits by means of lens-sensitized fowl-serum."

SPECIAL exercises honoring the late President Charles R. Van Hise, '79, will be held during Commencement week on Alumni day at the University of Wisconsin, June 24.

THE death is announced at the age of sixty years of Dr. Ferdinand G. Wiechmann, a consulting chemical engineer of New York City, known especially for his work on sugar chemistry.

LAWRENCE M. LAMBE, since 1884 on the paleontological staff of the Canadian Geological Survey, has died at the age of fifty-five years.

DR. ROBERT CHAPMAN DAVIS, lecturer on botany in the University of Edinburgh, recently captain in the Medical Corps of the British Army, has died from influenza at the age of thirty-two years.

UNIVERSITY AND EDUCATIONAL NEWS

WE learn from *Nature* that a gift of £210,000 to the University of Cambridge for a chemical school was announced by the Vice-Chancellor, Dr. A. E. Shipley, at the meeting of the senate on May 13. Particulars were given in the following extracts from a letter from Mr. R. Waley Cohen: "It has been an immense pleasure to me to be able to write to Sir William Pope and tell him that the British oil companies have agreed to join together in a scheme for endowing a chemical school at Cambridge. The Burma Oil Co. have agreed to contribute £50,000; the Anglo-Persian Oil Co., £50,000; the Anglo-Saxon Petroleum Co., £50,000; and Lord Cowdray and the Hon. Clive Pearson between them £50,000, making the total of £200,000 which is required. Mr. Deterding, who has taken very great interest in the scheme from the beginning, has offered to make the £200,000 into guineas by adding a personal contribution of his own of £10,000."

THE University of Cincinnati has established in its college of medicine a department in industrial medicine and public health. Under the plans submitted, $100,000 is to be raised by the citizens' committee on finance, for the support of this department for five years. The course will be started in October and will be open to graduates in medicine. A portion of the instruction will be given at the college and part at various industrial establishments along the lines now practised in the cooperative course.

THE Washington University School of Medicine, St. Louis, has been tendered the sum of $150,000 by the General Education Board on condition that an equal amount be raised by subscription. This fund of $300,000 is to be used for the endowment of the department of pharmacology.

THE board of trustees of the University of Tennessee voted $100,000 to the medical school to be used for a new laboratory building to be erected in the rear of the Memphis City Hospital. The new building will have laboratories for pathology, bacteriology, chemistry and physiology.

DR. EDSON SUNDERLAND BASTIN, of the United States Geological Survey, has been appointed to a professorship of economic geology in the University of Chicago beginning on January 1, 1920.

WILLIAM WALTER CORT, A.B. (Colorado, '09), Ph.D. (Illinois, '14), who is at present on the staff of the University of California, and consulting helminthologist of the California State Board of Health, has been appointed associate in helminthology in the school of hygiene and public health, Johns Hopkins University. His work in Baltimore will begin in the fall.

RECENT changes in personnel at the North Carolina State College of Agriculture and Engineering include the resignation of Professor C. L. Newman, head of the department of agronomy, Dr. G. A. Roberts, head of the department of veterinary medicine, and Dr. F. A. Wolf, head of the department of botany. Professor Newman is connected with the Fed-

eral Vocational Education Board with headquarters in Atlanta, Ga., Dr. Roberts has accepted an appointment as veterinarian with the Rockefeller Foundation and is to be stationed at São Paulo, Brazil, and Dr. Wolf will retain his connection with the North Carolina Agricultural Experiment Station.

Mr. Martin Kilpatrick, Jr., of the division of inorganic chemistry, the College of the City of New York, has accepted a position as assistant professor of chemistry at Vassar College under Professor W. C. Moulton.

Ernest Carroll Faust, A.B. (Oberlin, '12), Ph.D. (Illinois, '17), now instructor in zoology at the University of Illinois, has accepted a position with the China Medical Board, Rockefeller Foundation, as associate in parasitology, department of pathology, Union Medical School, Peking, China. He plans to assume his duties in Peking early in October.

Professor C. R. Marshall, professor of materia medica and therapeutics, University of St. Andrews, has been appointed to the regius chair of materia medica in the University of Aberdeen, vacant by the resignation of Professor Theodore Cash.

DISCUSSION AND CORRESPONDENCE

RADIUM PRODUCTION

To the Editor of Science: In your issue of March 7, Dr. Charles H. Viol makes some comments on statements made by me in a paper presented before the American Institute of Mining Engineers at its September meeting, 1918, at Colorado Springs. The main thing to which Dr. Viol takes exception is the statement of the writer that:

> In my judgment the carnotite fields will not produce more than 100 additional grams of radium element at the most—if that much. This would about double the world's present supply; but on account of the large use of radium in cancer treatment, such an amount, although large scientifically, would be small in proportion to the probable demands.

Dr. Viol states that the estimates of myself and the Bureau of Mines are based on a "very inadequate study of the carnotite region made prior to the war and before the fields had been developed to any great extent"; and he claims that at least 500 grams of radium should be produced from carnotite.

No one can tell exactly how much radium can be produced from the carnotite fields of Colorado and Utah, and any estimate must be very approximate. To some extent, the future production will depend upon the price of radium, as a much higher price for radium would allow lower grade ore to be mined and treated. As the ore always exists in pockets of varied sizes and grades, the mining is very largely confined to outcrops, and this makes the question of an estimation of the probable amount available easier than if mining conditions were such as are met with in connection with other metals. It is true that some drilling has been done, chiefly by the Standard Chemical Company, and a higher price of radium would, of course, allow drilling to be carried on to a greater extent, which would undoubtedly give some increased production. The estimate of 100 grams which I made was based on the present price of radium. But, under no conditions, can I see the possibility of producing 500 grams of radium element from the carnotite fields, or anywhere near that amount.

In reference to our "inadequate study of the carnotite region," I may say that the first statement of the Bureau of Mines concerning these deposits was made in connection with U. S. Bureau of Mines Bulletin No. 70.[1] On page 42 the following is printed:

> The United States possesses unique deposits in these carnotite ores. They constitute at present the largest known supply of radium-bearing minerals in the world. . . . Up to the present, very little interest has been shown by Americans in these deposits, which may not be duplicated in so far as quantity goes in any part of the world.

Up to this time, no one had made a statement of this kind concerning these deposits, but as soon as Mr. Kithil and myself went on record, there was immediately a strong tendency to "go us one better." In Volume 1, page 12, of *Radium*, published by the Stand-

[1] "A Preliminary Report on Uranium, Radium and Vanadium," by Richard B. Moore and Karl L. Kithil, 1913.

ard Chemical Company, we find the following signed by Dr. Brill, Dr. Viol's predecessor:

Conservative experts estimate the amount of uranium in this carnotite belt of Colorado to be about eight million pounds of U_3O_8. According to our experience, this would correspond to an amount of about 900 grams of radium, or about four pounds of pure radium bromide.

It must be remembered that our estimates have not been confined to this first survey. For nearly two years, engineers of the Bureau of Mines were constantly in the Paradox and surrounding regions in connection with the mining and ore-dressing operations of the Bureau, under its cooperative arrangement with the National Radium Institute.

This whole question came up last year at the Senate hearings on "Minerals and Metals for War Purposes." At the hearings, Mr. Flannery presented maps showing the recent drilling operations of the Standard Chemical Company, to which Dr. Viol evidently refers in his article. Mr. Flannery stated that these diamond drill operations had resulted in giving them an undoubted supply of ore for future purposes of at least 6,000 tons. The following is taken from the official report of the hearings:

Mr. Moore. Mr. Flannery, you stated that you had there probably about 6,000 tons of ore you could count on?

Mr. Flannery. Yes, sir.

Mr. Moore. May I ask about what your production of radium last year was?

Mr. Flannery. Our production of radium last year due to lack of transportation and chemicals was about 7 grams of radium.

Mr. Moore. How much ore did you use in that production?

Mr. Flannery. We used originally about 600 tons of the average ore to the gram of radium—that is 1/30 part of an ounce.

Mr. Moore. In other words, you have used about 4,500 tons of ore to get 7½ grams?

Mr. Flannery. I have not figured it out.

Mr. Moore. Therefore, your 6,000 tons would make less than 10 grams; you say you have 6,000 tons roughly blocked out there?

Mr. Flannery. You understand I am speaking now of the ore at the concentrator. Yes, sir; it takes about 600 tons, raw ore concentrated, or about 4 to 1 to give you a gram of radium with our practise.

Mr. Moore. According to your own statement, your total supply of ore would be not more than 10 grams.

Mr. Flannery. The total supply of ore. You mean the total amount to be mined?

Mr. Moore. I mean you have blocked out that; you stated you had about 6,000 tons of ore you could count on. Assuming that to be correct, then you could get from that less than 10 grams.

Mr. Flannery: No, you must figure something on some of that being of a little higher grade. The 6,000 tons of ore will probably run 1½ per cent.

Mr. Moore. I am taking your average production of ore last year as being the average of what you could get out of this, which would mean that there are less than 10 grams that you could count on, assuming that to be correct?

Mr. Flannery. Yes.

Further down on page 402 of the hearings, Mr. Flannery makes the following statement:

As regards the production of ore, Mr. Moore and I had a little talk last Saturday, and he claimed he though there were only 100 grams of radium in the Paradox Valley. I will take a contract for delivering 500 and put up a bond for the amount each year.

This evidence would seem to indicate that with the ore for 10 grams actually in sight, Mr. Flannery was willing to take a contract to deliver 500 grams. Of course, Mr. Flannery had other claims on which there were undoubtedly undeveloped bodies of ore; but the ore supply to which he referred was practically all that had been developed, and the amount was estimated on diamond drilling alone.

The original estimate of the Bureau of Mines was that the carnotite fields would probably yield from 100 to 200 grams of radium element. My more recent estimate represents an intermediate figure, since over 50 grams had been produced at the time it was made.

I have no criticism of the figures given by Dr. Viol in connection with mesothorium. He states however, that:

There are several points whose importance Dr. Moore and the Bureau of Mines have overlooked or minimized in their anxiety to conserve radium.

The points he refers to are as follows:

1. "The probable maximum production of mesothorium will not exceed the equivalent of 6 grams of radium per annum." I am perfectly willing to admit this, but 6 gram equivalents of mesothorium will go a long way toward relieving the present use of radium for luminous paint. This would exceed the average radium production of the Standard Chemical Company for the six years previous to 1918.

2. "The economical use of mesothorium in luminous compounds is only possible a year or two after refining." On the bottom of page 1,181 of my article on radium, referred to above, I stated: "After ripening for about a year after being prepared, it can be used for luminous paint just as efficiently as radium."

3. "For medical purposes, the short life and varying gamma ray activity of mesothorium make this product less desirable than radium." On page 1,182 of my article I state: "Mesothorium can also be used for cancer treatment, although its short life makes it much less desirable for this purpose than radium."

4. Dr. Viol prints a table to show the change of gamma ray activity of mesothorium with time. From this table, at the end of the second year, 78 per cent. of the activity has accumulated; and at the end of the ninth year, on the decay side of the curve, there is still 78 per cent. of the activity left. This would give seven years of useful life in luminous paint. In my paper, on page 1,182 I state: "Its usefulness for such purpose will last for four or five years, which is as long as is required for cheap watches, push buttons, etc."

In the same paper I make the following statement:

> But as the physicians and surgeons of the country are not purchasing enough radium to make the industry a financial success, it is natural that the manufacturers should take other means of creating a demand.

The main object of my remarks to which Dr. Viol has taken exception was to try and stir up the medical men of this country as to the future supply of radium. No one can blame manufacturers for getting other uses for their product if the main use is not taken advantage of. If the surgeons and hospitals will not purchase radium, it will naturally go to luminous paint and be used for any other purpose that will create a demand. I believe that Dr. Viol would much rather sell for medical purposes than for miscellaneous uses in which the radium is lost; and the writer would most certainly prefer to see such a condition come about.

During the war, a considerable amount of the radium abroad in England, France and Germany, which previously had been used for cancer treatment, was drawn on for war purposes. Even in this country, a number of physicians sold their supply. This condition makes still more important the presentation of the facts as they are to the medical fraternity.

R. B. Moore

U. S. Bureau of Mines,
Golden, Colo.

QUOTATIONS

THE FUTURE OF MEDICINE

Yesterday the British Medical Association concluded the most successful meeting in its annals. About the "atmosphere" of this unprecedented gathering there can be no mistake. It was one of serene and reasoned confidence in the future. The wisest leaders, who are also the most assured prophets, of the profession well know that it will not be given to them to enter the promised land which they see from afar. But they have stood upon the mountain tops and they have gazed upon it. That is enough. They will draw nearer to it; others who follow will cross its borders and continue the advance. None can set bounds to it, for it is infinite as the progress of human learning. This sense of its vastness, of its mystery, of its endless possibilities was the keynote of the meeting. The doctors realize that the war has opened to them a new world, and that it will be their high privilege to be able to apply to their fellow-men for all time the great store of new learning they have harvested on the battlefields of three continents. We can not pretend to review in this place the great number

of instructive papers and discussions which have filled these busy days. Some idea of them will have been gathered from the reports and the articles by our medical correspondent which we have published. But the general trend and spirit of the proceedings are sufficiently illustrated by the president's opening address. Like Sir Douglas Haig, Sir Clifford Allbutt had no new principles to announce. What he did was to restate with striking force and clearness some old principles, which occasionally appear to sink out of sight, and to show how they irradiate and inform whole masses of new facts. He does not hesitate to speak of the present as "the greatest moment in the history of medicine," or of the revelation to us that medicine has "come to a new birth." But when all is said and done, when all the magnificent examples of discovery and of interrelation have been described and arrayed, the widest and the most fundamental conclusion reached goes back from generation to generation to Coleridge, to Dante, and the schoolmen, to the greatest of the Greek thinkers. Coleridge insisted upon the interrelation of all knowledge, and invented the term "esemplastic" to describe it. "All things," wrote the great Florentine, "have order between them," and he declares that in this order lies the "form" which makes the universe like to God and in which angels see the impress of His power. The thought runs through the Divine Comedy, and guides him through the "gran mar doll' essere," as it does his master, Thomas Aquinas. How does it differ from the doctrine laid down by Sir Clifford Allbutt, when he tells us that "as the individual is but a link in the chain, so the human chain is a strand in the web of all living things." Our work, he says, must be upon the Aristotelian "double track" of the one into the many, and of the many into the one.

The principle is old, but the facts which have to be brought under it are overwhelming in their number and in their novelty. The war has added to them enormously, and has suggested complex systems of interrelation unsuspected before, besides affording incontrovertible proofs of truths seen but dimly until now. It is this seemingly endless progress upon lines known and established which makes medicine so fascinating to the scientific imagination. What can be more wonderful than some of the facts mentioned in this address; what more stimulating than some of the unsolved problems on which it touches? Sir Clifford dwells upon the light which modern physics throws upon medicine. He instances the electric methods of taking quantitative measurements of mechanical pressures in the circulation of the fluids of the body and in the heart, and he comes to the conclusion that apparently all biological reactions are determined by molecular structure. Above physics comes biology, but "we can not even guess at the links of the chains where physics recedes and biochemistry takes the lead." Merely to glance at the questions presented to us, he declares, is to discern "how vast is the realm of knowledge yet unconquered—nay, undiscovered." The tiny cell itself is a microcosm full of intense activities, which are beginning to emerge into the light through the labors of the mathematical physicist, of the spectroscopist, of the radiologist, and of the physical chemist. How are these new and vast worlds to be explored, and the knowledge of them adapted to the welfare of man? That is the practical problem. The yarn of biochemistry and biology, Sir Clifford says in a fine image, must be continually carried and woven into the web of the practising doctor's art. It is impossible for any man in practise, whatever his abilities and his industry, to perform the work for himself. He can not by his unassisted efforts keep pace with the great tide of fresh learning that is sweeping in upon him. There must be some intermediary between the working doctor and the men devoted to laboratory research—some middlemen, some *liaison* officers to keep them in touch—and the investigator, be it remembered, needs this touch as much as does the practitioner; the bedside and the laboratory must work hand in hand, if either is to derive the fullest fruit from the interrogation of nature. Sir Clifford is clear that in every good clinical school there ought to be a body of whole-time professors with

fully-equipped laboratories and staffs, who should be "continually irrigating the profession from the springs of the pure sciences." In that way, or in another, the problem must be solved, if English medicine is to keep its unsurpassed position in the world.—The London *Times*.

SCIENTIFIC BOOKS

A Sketch of the Natural History of the District of Columbia, together with an Indexed Edition of the U. S. Geological Survey's 1917 Map of Washington and Vicinity. By W. L. McAtee. Bulletin of the Biological Society of Washington, No. 1, May, 1918, pp. 142, 5 maps.

Reliable information regarding the biology of restricted areas is, for many reasons, of much value far beyond its mere local significance. The capital city of our country has been fortunate during the past century in the many famous naturalists that have either resided or studied here. The present comprehensive though succinct account of biological aspects of the region about the city of Washington is therefore most acceptable. Its purpose is to present a brief biological history of the District of Columbia, to point out the best places for field study, and to furnish geographical assistance in locating them. Thus the bulletin falls naturally into three parts: (1) A historical sketch of the various branches of natural history in their relation to the District of Columbia; (2) an account of the distribution of life in the District of Columbia region; and (3) an index to the United States Geological Survey's 1917 map of Washington and vicinity.

The history of the biology of the District of Columbia, it is interesting to note, dates back, we are told in a brief introduction, to the year 1608, and the redoubtable Captain John Smith of Pocahontas fame was the first observer. A number of early authors on general subjects have references to the animals and plants of the region.

The first information regarding the botany is by Petiver in 1698, who published some notes on animals and plants sent him from Maryland. The first actual list of plants of the District of Columbia appeared in 1816, as a part of David Baillie Warden's "Chorographical and Statistical Description of the District of Columbia," and contained 142 species. A résumé of the progress of botanical study in the District of Columbia since that time down to the present shows a final list of 1,598 species, many of which have been described as new from local material. A short botanical bibliography includes the most important local publications.

The first insects from the District of Columbia were recorded in 1816 by Warden, but little was known of this group until 1859, when Baron Osten Sacken began the publication of his important articles on the insect fauna of the District. Many workers since his time have, like him, found the District of Columbia excellent collecting ground for insects, and the total list of species for the region is now very large, including 3,000 beetles alone. Many hundred species, chiefly diptera and hymenoptera, have been described from material collected near Washington. A partial bibliography, arranged according to orders and covering 16 pages, shows graphically the activity of local entomologists. Of other invertebrates there have been recorded from the District 90 species of mollusks, 308 species of spiders, 10 species of phalangids and 246 rotifers.

Fishes have here received more attention than any other group of vertebrates excepting birds, and the list of species now totals 94, several of which were described from specimens taken in the vicinity of Washington. The distribution of fishes in this region is made interesting by the fact that tidewater ends here, so that in addition to the freshwater fauna at least 26 species of salt-water fishes occur more or less regularly.

Of batrachians, 27 species are said to occur; and of reptiles, 36. The only poisonous snake at present extant is the copperhead, though the rattlesnake formerly lived in this region. As with the other groups, the account of reptiles and batrachians is followed by a short bibliography.

The birds of the District of Columbia have been more closely studied than any other group of vertebrates, and the present total comprises about 300 species and subspecies. The earliest list of the birds of the District of Columbia, consisting of 322 species, was published by David Baillie Warden in 1816. There are, however, scattered through the writings of earlier authors, many references to the birds of this region. A partial bibliography mentions the more important papers on the avifauna.

Of mammals there are now 41 species known from the vicinity of Washington, of which 3 were originally described from material collected here. It is of more than passing interest to note that within historic times the buffalo, elk, white-tailed deer and puma all lived about Washington.

A brief account of the history of early man in the District shows that the North American Indians inhabiting this region were of Algonquian stock, but all departed about the year 1700.

The most important part of this bulletin, at least from the standpoint of general biology, is the discussion under the "Distribution of Life in the District of Columbia Region," and particularly that relating to the piedmont plateau and coastal plain as faunal and floral provinces. The characteristics of the piedmont plateau and the coastal plain are explained, as is also the geological significance of the fall line separating them. The text-figure map showing the fall line and also the islands of coastal plain deposits within the piedmont plateau area is an illuminating addition to this discussion. The conclusion reached is that the fall line acts as a more or less definite faunal barrier, most so in the case of plants and insects. The substantiation of this statement, so far as the plants are concerned, is furnished in long lists of species restricted respectively to the piedmont plateau and to the coastal plain.

Fully as interesting from an ecological point of view is the discussion of the magnolia bogs about Washington in their relation to the pine barrens of New Jersey. The author seems conclusively to show that a large percentage of characteristic pine barren plants are present in these magnolia bogs (so called because the swamp magnolia [*Magnolia virginiana*] is the one plant never absent from them), and to reach the apparently sound conclusion that the absence of pine barrens in the District of Columbia region is due solely to the absence of extensive areas of suitable soil deposits. These magnolia bogs, by furnishing a habitat where the typical pine barren plants are relieved from competition with the ordinary vegetation of the district, serve to preserve the survivors of the plant waves that accompanied the successive depressions of the Atlantic Coast region.

An account is given also of the other types of collecting ground about Washington, with mention of localities where such are to be found, together with some of the more desirable plants and animals to be obtained at each.

A decidedly useful feature of this bulletin is a map of the District of Columbia and vicinity in four sheets, on which, by means of close cross index lines, the old collecting spots, archeological sites, and minor topographical details have been indicated, so far as it has been possible to ascertain them. An index of 23 pages furnishes a ready means of reference. The map and its index have apparently been prepared with exceedingly great care, and will prove a boon to any one who has occasion to work on the local natural history.

Mr. McAtee has brought together an astonishing amount of important, not to say interesting, information concerning the biota of the District of Columbia, and not only will his bulletin prove a mine of riches for the local student, but will, as well, be of value to all ecological investigators.

HARRY C. OBERHOLSER

SPECIAL ARTICLES

THE AMPHIBIOIDEI, A GROUP OF FISHES PROPOSED TO INCLUDE THE CROSSOPTERYGII AND THE DIPNEUSTI

THE typical fishes or Teleostomi (Osteichthyes) obviously form a monophyletic group,

being distinguished from the Elasmobranchii (Selachii) by: the development of true scales and of two related structures—articulated fin rays and membrane bones, the latter including an opercle covering the branchial clefts; the reduction of the interbranchial septa; the presence of a developed air-bladder or lung, of two external nostrils on each side; the lack of pelvic claspers (mixipterygia), etc. The Teleostomi, as Mr. C. Tate Regan[1] has recently stated, "may be arranged in two series: in the Actinopterygian series (Chondrostei and Teleostei) the duct of the air-bladder opens dorsally or dorsolaterally into the alimentary canal, the branchiostegals retain their primitive serial arrangement, and the supports of the paired fins are either in the form of a series of parallel pterygiophores each of which is segmented into a basal and a radial portion or are modified from this plan by a simple process of concentration and reduction; in the Crossopterygian series (Crossopterygii and Dipneusti) the opening of the pneumatic duct is ventral, the branchiostegals are replaced by a pair of gular plates, and the paired fins are more or less lobate, with their supports tending to the biserial arrangement with axial basalia." The first of these two series, the primary subdivisions of the Teleostomi, is known as the Actinopterygii or Actinopteri; the second series apparently has received no definite name. As both morphological and paleontological[2] evidence indicate the monophyletic naturalness of this group, it should receive a distinctive designation; to indicate its similarity and relationship with the primitive Amphibia, this group, comprising the Crossopterygii and the Dipneusti (Dipnoa), may be termed Amphibioidei.

The taxonomic rank to which the Amphibioidei may be assigned is largely a matter of personal opinion. The writer would classify the group in serial arrangement among other chordates as follows, leaving out of consideration several groups wholly extinct and of doubtful affinities (of these the Arthrodira or Arthrognathi have often been regarded as related to the Dipneusti or the Crossopterygii):

Subphylum Euchorda.
- *Superclass* Pisces.
  - *Class* Marsipobranchii.
  - *Class* Elasmobranchii.
  - *Class* Teleostomi.
    - *Subclass* Actinopterygii.
      - *Superorder* Chondrostei.
      - *Superorder* Holostei.
      - *Superorder* Teleostei.
    - *Subclass* AMPHIBIOIDEI.
      - *Superorder* Crossopterygii.
      - *Superorder* Dipneusti.
- *Superclass* Tetrapoda.
  - *Class* Amphibia, etc.

CARL L. HUBBS
FIELD MUSEUM OF NATURAL HISTORY

[1] *Ann. Mag. Nat. Hist.* (8), 3, 1909, p. 76.

[2] Dollo, *Bull. Soc. Belg. Géol.*, 9, 1895, p. 79.

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE Buffalo meeting of the society, known as the "Victory" meeting, was held April 7 to 11 and was attended by approximately 1,100 chemists, and was one of the most enthusiastic meetings the American Chemical Society has ever held. Professor Giacomo Ciamician was elected an honorary member of the society as Italy's leading organic chemist. Publication of compendia of chemical literature and monographs was undertaken by the society and committees appointed to carry the plan into effect. The society also joined with the National Research Council in approving the formation of an International Research Council and an International Chemical Council in which all neutral nations were to be allowed to participate on the same basis as the allies. The society again took a strong stand against the free importation of chemicals and chemical apparatus for educational institutions, believing that such a privilege not only retarded the production of such materials in this country, but it also created a false impression as to the superiority of foreign-made materials. The society voted that at the Philadelphia meeting which is to be held from September 2–6, inclusive, a Dye Section of the society should hold meetings with Charles L. Reese, as chairman. The opening meeting on Tuesday, April 8, was made especially interesting by the three following addresses, which have been published in full in the May issue of the *Journal of Industrial and Engineering Chemistry:*

Introductory remarks on *The future of American chemical industry:* WILLIAM H. NICHOLS, president, American Chemical Society.

American chemical industries and the tariff commission: WILLIAM S. CULBERTSON, U. S. Tariff Commission.

German methods and our present situation: JOSEPH H. CHOATE, JR., Chemical Foundation.

A paper by Irving Langmuir on "The arrangement of electrons in atoms and molecules" proved so interesting that, on request, it was given a second time to a large audience of several hundred, some of whom were unable to attend the first presentation.

The following symposium on "Mustard Gas" with Wilder D. Bancroft, as chairman, was also especially well attended, and although abstracts of the papers have not been furnished, the papers themselves, will be published in the society's journals.

The social affairs of the meeting and the excursions were well planned and were a credit to the energy and good fellowship of the Western New York Section. The ladies were given a round of entertainment at the local clubs, theater parties and teas, and were also prominent at the banquet. Over 800 members of the society sat down to the smoker on Tuesday evening and enjoyed the lavish refreshments and entertainment offered by the Smoker Committee. The extensive excursion program was also enjoyed on Thursday afternoon and Friday to the chemical industries of Buffalo and Niagara Falls.

MUSTARD GAS SYMPOSIUM

Wilder D. Bancroft, *Chairman*

General properties: W. D. BANCROFT.

Mustard gas at the front (lantern): B. C. GOSS.

Chlorhydrine synthesis: M. GOMBERG.

Sulfur chloride synthesis: J. B. CONANT.

Manufacture of mustard gas: WILLIAM MARSHALL.

Tests: A. B. LAMB.

Accelerated hydrolysis: R. E. WILSON.

Permeability of protoplasm: CLOWES, LILLIE and CHAMBERS.

Permeability of skin: CLOWES, MARSHALL and SMITH.

Protective ointments: R. E. WILSON.

Protective clothing: A. E. HILL.

Protective clothing: CLOWES, GORDON and GREENSFELDER.

Persistency: A. B. LAMB.

The action exerted by antagonistic electrolytes on the electrical resistance and permeability of emulsion membranes: G. H. A. CLOWES.

Some reactions of mustard gas: O. B. HELFRICH and E. EMMET REID.

DIVISION OF AGRICULTURE AND FOOD CHEMISTRY

W. D. Richardson, *Chairman*

T. J. Bryan, *Secretary*

Sampling tankage and the effect of moisture on the ammonia content: PAUL SMITH.

Light weight vs. heavy oats: P. F. TROWBRIDGE.

Soft corn—its composition and nitrogen distribution: GEORGE SPITZER, R. H. CARR and W. F. EPPLE. A study has been made of the composition of the dry matter of corn which has been prevented from maturing, because of injury by frosts. The investigation also included the distribution of the nitrogen found in both mature and soft corn. It has been found that the soft corn is high in amide nitrogen in proportion to its softness, and that the zein content is lower in about the same proportion as the amide is higher. A circular diagram is presented, showing the relative amounts of amide, zein, globulin and glutelins present in both the mature and soft corn. Less of the total proteins in mature corn was found to be zein than has been reported. A separation of the nonamines from the diamines was made by the Van Slyke method, but no great difference in the nitrogen distribution was noted between soft and mature corn. The true starch is usually thought to be higher in mature corn, but this did not prove to be the case, as the fat which seems to be made last is at the expense of the starch, whereas in soft corn the frost caught it before there was a chance for starch to be changed over to the fat, hence the fat content of soft corn was only about one half of that of the matured.

A modified valenta test for butter: CHARLES P. FOX.

Heat penetration in processing canned foods: W. D. BIGELOW, G. S. BOHART and ALLAN C. RICHARDSON.

A further study of the DeRoode method for determining potash: T. E. KEITT.

The loss of moisture from sugar samples under different methods of preservation: C. A. BROWNE and G. H. HARDIN. The loss of moisture from raw sugar samples in tin cans and glass jars, unsealed and with various methods of sealing, was determined. The daily loss from sugar in ordinary tin cans varied usually from 0.01 per cent. to 0.02 per

cent., about 40 per cent. of the loss being between cover and can and 60 per cent. through the seams of the can. The loss between cover and can could be prevented only by adhesive tape made impervious with melted wax or paraffine. The employment of corks in glass jars or bottles did not afford a tight seal. Dipping the corks in melted wax or paraffine did not prevent loss of moisture owing to the heated air in the corks producing blow holes. A second dipping usually made the corks tight. Fruit jars sealed with a rubber ring and glass cover did not make a tight container. Glass jars with ground glass stoppers prevented drying out only when sealed with melted wax or paraffine. The objection against glass containers is the breakage during shipment. The only effective metal container is a seamless swaged can with cover sealed with adhesive impervious tape; the difficulty of the method is that of making a seamless can of sufficient size.

Diets of various birds and mammals: W. D. Richardson.

The diets of various peoples in the light of the Vitamine doctrine: W. D. Richardson.

The indispensability of milk in the adult diet: W. D. Richardson.

DIVISION OF PHARMACEUTICAL CHEMISTRY

F. O. Taylor, *Chairman*

George D. Beal, *Secretary*

Cooperation in drug research: F. R. Eldred.

Simple physical and biological models with which to study the penetration and function of drugs: G. H. A. Clowes.

Western poisonous plant investigations: O. A. Beath.

The U. S. P. assay for mercurial ointment: L. F. Gabel.

Alkaloids: M. H. Webster. Alkaloids are the active principles of plants and decomposed animal matter. Research work on alkaloids is intimately connected with the development of synthetic pharmaceutical chemicals and laid the foundation stone upon which the whole structure of organic dyes has been built. Reference is made to the discovery of alkaloids resulting from the search for those principles which differentiate the physiological action of drugs. Practical problems in the isolation and purification are discussed, and an attempt is made to trace these difficulties to alkaloidal functions in plant metabolism. Yields obtained in manufacture are compared with U. S. P. processes and the status of alkaloidal drug assay is viewed alongside the ideals sought for in all analytical methods and results.

The preparation of vitamine-activated fuller's earth: Atherton Seidell and R. R. Williams.

Further studies of the properties of the vitamine of brewers' yeast: R. R. Williams and Atherton Seidell.

Chloretone: trichlor tertiary butyl alcohol: H. C. Hamilton.

Color standards for cottonseed oil: H. V. Arny. A discussion of the classification of commercial cottonseed oil samples by color and the unsatisfactory character of the methods hitherto employed. A résumé of the work previously done by the author and his pupils on standardized colored fluids and their use in colorimetry. A report on the use of these fluids in matching the color of cottonseed oil: the conclusions being that prime white, choice summer yellow and off summer oils can be matched by proper blends of normal or half-normal acidulated ferric chloride solution, half-normal acidulated cobalt chloride solution and water: the exact figures being given in the paper.

DIVISION OF BIOLOGICAL CHEMISTRY

I. K. Phelps, Chairman

R. A. Gortner, Vice-chairman and Secretary

Capsaicin, the pungent principle of capsicum: E. K. Nelson. Oxidation of methyl capsaicin (formed by treating capsaicin with di-methyl sulphate), gives veratric acid. Hydrolysis of capsaicin gives vanillyl amine (4-hydroxy-3-methoxy-benzyl-amine) and a decylenic acid. Capsaicin is found to be a condensation product of 4-hydroxy-3-methoxy-benzyl-amine and a decylenic acid. The decylenic acid, when hydrogenated, does not produce normal capric acid but an isomer of capric acid.

The relation of the physical properties of organic compounds to their toxicity to insects: William Moore. The results of a series of experiments with a large number of different chemicals show that the toxicity to insects of the vapor of an organic compound is correlated with its volatility or boiling point. The reason for this relation is due to the fact that in general a saturated or nearly saturated atmosphere is required before the vapor can gain entrance to the insect. Such an atmosphere is obtained by the use of smaller quantities of chemicals with high boiling points or low volatility. The factor of penetration is sufficient to completely mask the true toxicity due to chemical structure.

Studies of the chemotherapeutic type upon insecticides and fungicides: C. L. ALSBERG.

The absence of fat-soluble: A "vitamine" in glandular fats: A. D. EMMETT and G. O. LUROS. Fat extracted from the pancreas, thymus and suprarenal glands with acetone and ether was incorporated in a diet that was complete for normal growth in rats, except for the absence of the "fat-soluble A" accessory. Comparing the effect of these rations with that obtained with control group where a normal diet and one lacking in fat-soluble A were fed, it was found that none of the three glandular fats contained this accessory or "vitamine." The use of the desiccated thymus in the therapy of rickets would therefore seem to bear no relation to the presence of the fat-soluble A, as has been claimed by some.

The nutritive value of peanut and soy bean flours as supplements to wheat flour: C. O. JOHNS, A. J. FINKS and MABEL S. PAUL. Bread containing 75 per cent. wheat and 25 per cent. of peanut or soy bean flours, together with a suitable salt mixture and butter fat, produced normal growth when fed to albino rats. These diets contained approximately 18 per cent. of protein. Normal growth was also obtained when the total protein content of the diet was only 11 per cent. Controls were made by using wheat bread as the only source of protein and the growth was one third to two thirds normal, this diet containing 11 per cent. of protein. The investigation is still in progress.

A volumetric method for the detection and estimation of neutralizers in dairy products: L. W. FERRIS. By the use of picric acid and a standard hydrochloric acid solution the inorganic salts are separated from the milk proteins and the ratio of the alkalinity of these salts to the inorganic phosphoric acid is determined. This ratio is fairly constant for normal dairy products and is increased by the presence of neutralizers, the increase being in proportion to the amount of neutralizer present. The ratio is determined on samples of normal and neutralized products and a formula given for calculating the amount of neutralizer in a given sample.

Carbon monoxide—a respiration product of kelp: SETH C. LANGDON. It was determined that the carbon monoxide in the floater of the Pacific Coast kelp, *Nereocystis luelkeana,* is a by-product of respiration and not an intermediate step in photosynthesis. This was accomplished by substituting gases of known composition for those normally present in the kelp and then by analysis noting any change in composition. Carbon monoxide was formed only when oxygen was present in the substituted gas. It was formed both in the light and in the dark. Carbon monoxide was not formed within plants which had been killed nor was it formed when macerated kelp is allowed to decompose or undergo autolysis. This formation of carbon monoxide within a living plant is unique.

The effect of X-rays on the length of life of Tribolium confusum: WHEELER P. DAVEY.

The occurrence of gossypol in different varieties of Cottonseed: C. L. ALSBERG, E. W. SCHWARTZE and E. T. WHERRY.

Criticism of the Eckert method of determining nitrogen by the Kjeldahl method in nitro derivatives: I. K. PHELPS.

A discussion of the accuracy of the determination of nitrogen in organic substances by the Kjeldahl method: I. K. PHELPS.

Do mold spores contain enzymes? (By title.) NICHOLAS KOPELOFF and LILLIAN KOPELOFF. The query "Do mold spores contain enzymes" has been answered in the affirmative by the experimental data herein presented. The spores of *Aspergillus niger* heated to 63° C. for 30 minutes and shaken with sterile sand, caused a decrease in polarization and in increase in reducing sugars in a 10 per cent. sterile solution in 3 hours, and continued the same changes throughout the 4-day incubation at 45° C. These results were corroborated when a 20 per cent. sugar solution was similarly inoculated. Spores heated to 100° C. caused no change (neither did an inoculation with sterile distilled water) proving that the activity mentioned above was enzymatic in nature. The enzyme present exhibited activities identical with invertase, consequently the spores of *Aspergillus niger* contain invertase. Among the practical applications of this phenomenon the deterioration of manufactured cane sugar and certain transformations in the soil are especially significant.

The influence of ammonium hydroxide on the oxidation of acetone and on the acetone yield from the oxidation of butyric acid (by title): EDGAR J. WILTZEMANN.

The biological test for determining the fertilizer needs of a particular soil or crop: R. P. HIBBARD and S. GUSHBERG.

The quantity and composition of ewes' milk: its relation to the growth of lambs (by title): RAY E. NEIDIG.

An experimental study upon the impregnation of cloth with pediculicocidal substances: W. MOORE

and A. D. Hirschfelder. Substances were tested by placing 1 gram on a piece of underwear cloth 6×8 cm. and wearing next to the skin. Small strips were cut off every 12 hours and placed in a glass vessel with lice and eggs. When 100 per cent. were killed in 24 hours the substance was regarded as active. Of 170 substances previously tested cresol was found to be the best, but killing properties lasted only 24 hours when worn. Mono-, di- and tribrom cresols were prepared. Dibrommeta cresol was active for 10 days and dichlor monobrom meta cresol for 13 days and the sodium salts of tribrominated crude cresol lasted 15 days. These outlasted any substances thus far used in practise.

Organic Division

Lauder W. Jones, *Chairman*

H. L. Fisher, *Secretary*

The use of sulfur chlorides and chlorine for the production of organic acid chlorides from organic acids: Roger Adams.

Synthesis of chlorine derivatives, III.: R. R. Renshaw and C. E. Greenlaw.

Trimethyl phosphine and certain of its derivatives: R. R. Renshaw and F. K. Bell.

Trimethyl arsine and its selenide: R. R. Renshaw and G. E. Holm.

Phenylimido phosgene and some reactions of formanilide: W. Lee Lewis and G. A. Perkins. Phenylimido phosgene was prepared in 95 per cent. yields from thiocarbanilide by chlorinating in carbon disulphide or carbon tetrachloride solution. Phenylimido phosgene itself may be used as a solvent for the thiocarbanilide on chlorinating. No difficulty was experienced with ring chlorination and Nef's method of adding water to the reaction mixture before purification was found unnecessary. With a view to obtaining phenylimido phosgene from formanilide, it was found that chlorination in the presence of sulphur chlorides led to the formation of 2–4 di-chlor formanilide. In the presence of thionyl chloride chlorination of formanilide yields phenylamido chloroform.

The ammono-carbonous and ammono-carbonic acids: E. C. Franklin.

The reaction between dimethyl sulfate and benzene: Oliver Kamm and S. D. Kirkpatrick.

Contribution to the study of the relationship between chemical constitution and physiological action: Oliver Kamm.

A study of some of the carbohydrates of the corn cob: R. R. Renshaw and W. J. Suer.

Synthesis and properties of certain dyes containing the furane cycle: R. R. Renshaw and Nellie M. Naylor.

The preparation of pure organic chemicals: H. T. Clark.

Acetylene: William Malisoff and Gustav Egloff.

Ethane: William Malisoff and Gustav Egloff.

The occurrence of melezitose in honey: C. S. Hudson and S. F. Sherwood.

The chemistry of electrical insulators: H. C. P. Weber.

The estimation of mercaptans: R. L. Kramer and E. Emmet Reid.

Alcoholysis as a factor in the determination of saponification values: A. M. Pardee and E. Emmet Reid.

1, 2-dicholoroether: E. A. Wildman and Harold Gray. In the preparation of 1, 2-dichloroether by direct chlorination of ether it has been found that the process may be readily carried out if two precautions are observed: (1) In order to prevent the material catching fire spontaneously the ether must be at first cooled with an ice and water bath and the chlorine passed in very slowly. (2) To facilitate the escape of the hydrogen chloride formed in the reaction it is practically essential to agitate the mixture violently. Otherwise it tends to accumulate and then suddenly escape with sufficient violence to blow the contents out of the flask.

Aromatic ethers: J. M. Johlin. This paper outlines new methods for making aromatic ethers which are symmetrical, and for certain non-symmetrical aromatic ethers which have not been made heretofore.

Charles L. Parsons,
Secretary

(*To be concluded*)

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE AIRPLANE IN SURVEYING AND MAPPING

THE airplane, while not a product of the war, owes its present prominent place to the war, and but for the war its development would have been retarded many years. It had few practical uses from the time the Wright brothers first flew their machine at Fort Myer, Va., in 1909 until 1914. It was a plaything to amuse the holiday crowd.

The war changed this situation. The allies and the central powers almost immediately saw the great importance of the airplane in battle and the best brains and energy of the warring nations were given to the problem of making the airplane perform what a few years ago would have been considered miraculous things.

War planes were made for various purposes, which I need not enumerate. But the most important thing done from the airplane was photographing the enemies' lines to obtain many kinds of military information, such as positions of batteries and ammunition dumps, changes in trench systems, troop movements, etc.

The same methods, with some modifications, are now being considered in connection with the mapping of extensive areas by various organizations of this country. In fact, some work has already been done and experiments are being carried on which promise excellent results.

There is so much misinformation regarding surveys and maps, that it seems appropriate for me, as the head of the oldest map-making bureau of the government, to present the mapping situation to this congress, both for your information and as a matter of record.

Surveying and mapping have long histories and the development of the methods now employed took centuries. But the method of airplane surveying has developed like a mushroom. To what extent is it applicable to our needs? This I shall endeavor to show.

In collecting data for a map those surveying methods must be adopted in any particular case that suit the requirements. If one should wish only a route map running from one village to another, it would be perfectly satisfactory to use a compass for direction and the pacing of a horse or the readings of an odometer on a wheel for the distance between the two points. But maps are usually not so simple as that.

TYPES OF MAPS

There are several types of high grade maps needed in this country. One must be made along the coasts to show the location of the actual shore line and the character of the ground immediately back of the coast in order that the navigator may be able to locate himself from topographic features along the shore, should he be driven off his course during a storm. In addition the depths of the water and all obstructions to navigation must be indicated on this map or chart, and the elevation and shape of the ground on islands and near the shore line must be shown by contours.

A second class consists of maps on which the features other than elevations are shown in their correct horizontal positions. This type of map would be practically the same as the third type where the area covered is very level like the coastal plain of Louisiana.

The third class covers maps of the interior or of large islands on which all features, cultural and natural, are located in their proper horizontal positions and contours are shown to give the elevations of the ground and the shape of the hills, ridges, valleys, etc. This map would be used by engineers in laying out railroads and highways, and in conducting various classes of engineering work.

These three classes of maps are the ones in which we are most directly interested.

The map which shows the horizontal positions of cultural and natural features on the surface of the earth, but no contours, can be made more rapidly than the one which requires contouring. All that is needed in the former case is some method of obtaining the direction and distance between each two features in the area to be surveyed. The usual method of making such a map is by compass and chain, transit and tape, transit and stadia, or by the plane table. These methods are all very closely allied and such accuracy as may be demanded may be obtained by varying the methods used.

MAPS CONTROLLED BY FIXED POINTS

In any event there must be within the area to be surveyed, if it is a large one, a number of control stations. These control stations consist of triangulation stations placed on the highest parts of the ground or traverse stations along the roads, accurately located in latitude and longitude and accurately and substantially marked with concrete or rock in order that they may be recovered and identified by the surveyors or engineers who may wish to see them.

There are now many thousands of such stations in the United States, established principally by the Coast and Geodetic Survey, available for the fundamental control of surveys and maps. From these stations control of the same or of a lower grade of accuracy may be extended in any direction for the immediate control of topographic maps.

OVERLAPS, GAPS AND OFFSETS TO BE AVOIDED

It is readily seen that without the fundamental control, which extends over the whole area of the United States, there would be great confusion. If the control in any one state is not properly coordinated and correlated with that of any other state near it, the result will be that when different topographic surveys and maps are joined there will be overlaps, gaps and offsets which cause no end of trouble and confusion to the cartographer and map maker. When there is a single system of control for the whole country we avoid this unfortunate condition.

3,000,000 SQUARE MILES, LESS THAN ONE HALF MAPPED

There is to-day only about 40 per cent. of the 3,000,000 square miles of the United States mapped both as to horizontal positions of the

features and the elevations by contours of hills, ridges, valleys, etc. These are the maps of class three, mentioned previously. Some of the 40 per cent. of the surveyed area will have to be resurveyed because the original work was done many years ago when methods were not as refined as they are at present and the demands of map users were not as exacting as they are to-day. It is safe to say that not over 30 or 35 per cent., or one third of the whole country is adequately mapped.

The question is, what shall be done with the other 60 per cent. This is a question that is puzzling map makers constantly and no ready solution is at hand provided we insist on having a map of the whole area within a few years.

It is possible that here may be a valuable field for the airplane. It is not believed that the airplane unsupported by other surveying can give the final accuracy required in original survey. But by its means a map can be made that will be much better than the maps which may be in existence to-day in the areas not topographically mapped. In order that the remaining 60 per cent. of the country might be mapped by airplane it would be necessary to have a great amount of triangulation and traverse run with a view to furnishing the horizontal control for the photographs to be made by the airplane. With this control, it would be possible to fit the photographs on the map into their proper positions.

AIRPLANE SURVEYING WILL DEVELOP

It is not possible to run many miles with airplane photographs and expect a very high degree of accuracy in the resulting maps. And here I wish to give a word of caution to the advocates of airplane mapping. Too much must not be expected of it. The development of this science will undoubtedly be rather slow for a few years. After it has been developed the methods must, of course, be thoroughly tested before they can be adopted. It is well that this is so, for otherwise haste might cause mistakes which would discredit the method to such an extent that it would take years to recover.

CHARTS OF THE COAST

The first class of maps considered here consists of charts of the Coast and Geodetic Survey which show the level area immediately along the coast and the water area for some distance out from the shore. The purpose of coast charting is to furnish a safe means of communication by vessels along the coast or in approaching the coast. At present, the methods employed are the usual ones for the topographic surveying of the shore line and the area immediately back of it and the ordinary hydrographic methods for the surveying in the water.

Although the coast line of the United States has been mapped, yet the currents and waves of the oceans cause many large changes in this shore line. For instance Fire Island entrance, Long Island, New York, was changed in position about four miles in fifty years. The changes are so rapid that frequent resurveys of the coast must be made to furnish exact and reliable information to the navigator. It is also necessary to revise the area just back from the coast, for roads are frequently changed in position or abandoned, new ones are established, houses are built or burned, villages spring up, woods are removed or grow over what were vacant fields at the time the map was made, and all of these changes should be shown for the use of the mariner. The question arises as to how such revision shall be made.

REVISION OF CHARTS BY AIRPLANES

From the experience of the engineers of the Coast and Geodetic Survey the revision of an area that does not need contouring is almost as expensive and takes almost as much time as the original survey, for it is necessary to make a test of the position of each feature. It is here that the airplane will be of the greatest service, for if a portion of the shore line needs to be inspected with a view to learning whether or not the map of it should be revised, we could have a series of photographs made by an airplane along the coast, and a comparison of these photographs with the original map would enable one to locate very defi-

nitely each area within which there are new features or where old ones have changed. It is doubtless true that in such cases the details of an airplane photograph could be placed on the map from the photograph with all of the accuracy that is needed in the topography shown on the coast charts.

It is a debatable question as to whether the airplane photograph made over a water area will show any outline of submerged dangers to navigation when the plates are developed. If they do there is a vast field for the airplane in making photographs over water areas where it is known that many obstructions exist. With the usual surveying methods, it is difficult at times to locate every obstruction. One or more on any chart might be missed. This fact has been proved a number of times in a most disastrous way by vessels running on uncharted rocks both along our eastern and our western coasts and especially in Alaska.

The Coast and Geodetic Survey is now making wire drag surveys of all doubtful areas along the coast, but it will be many years before the bureau can assure the navigating public that all obstructions have been found and accurately charted.

AIRPLANES AND HYDROGRAPHIC SURVEYS

It may be possible that an airplane photograph will indicate submerged rocks or other dangers that are close to the surface of the water. It would be a question of differences in shade in the photograph. If such a detection of danger can be made then it will be necessary to make the photographs only on perfectly clear days. Otherwise, the shadow on the water of a passing cloud might show on the photograph and cause uncertainty as to whether the spot was a cloud or an actual obstruction.

There are many hundreds of square miles of area along the coast that consist of salt marshes with many streams of little or no importance, but which should be shown in their proper relation to other topographic features. These marshes can be photographed from airplanes and the streams running through them would probably show in such a way that they could be fitted into the map from the photograph. Here might be a large saving of time for the surveyor in the field.

There are other cases where there are extensive mud flats, when the tide is low, as in Jamaica Bay, New York. To survey the outline for these flats is rather laborious, with the usual instrumental methods, but it is believed that it might be possible to photograph them from an airplane and have the results placed on charts. It will undoubtedly be possible to get these located on the charts from airplane photographs with all the accuracy that is necessary for the navigator.

LOCATION OF DANGERS TO NAVIGATION

In making photographs from the water, for the purpose of discovering obstructions to navigation at low tide it will be necessary to have some means to properly locate photographic features on the chart. This probably can be done by anchoring two or three small boats within the area of the photograph and locating them with relation to triangulation stations. The location could be done in the usual way in which the sounding boat is today given its position, that is by taking two sextant angles simultaneously from the boat to three control points. It can readily be seen that if two or three accurately located boats are clearly shown on the aeroplane photograph, it will be possible to place the topographic details on the map in their proper positions.

I do not wish to convey the idea that the airplane photography will supersede the usual methods of hydrographic surveying, but it would supplement those methods by making it possible to discover channels running through mud flats, also coral heads, shoals, and other obstructions which might be close to the surface of the water and which may be missed by the usual methods of conducting hydrographic surveying.

There has been a rather positive statement made above that the airplane can be used to advantage in the work of the Coast and Geodetic Survey. This is undoubtedly true, but only time and the development of the methods

can show just how much the airplane can be used by this bureau.

THE AIRPLANE IN TOPOGRAPHIC MAPPING

We come now to the third class of maps and that is a subject on which I hesitate to express an opinion. That is the mapping of the interior of the country. This work is undertaken by the U. S. Geological Survey, supplemented to a certain extent by the Corps of Engineers, U. S. Army. The Coast and Geodetic Survey cooperates with those two organizations to the extent of furnishing the fundamental horizontal and vertical control for the surveys and maps, but almost all of the actual location of artificial or natural features is done by the other organizations. It is understood that the officers of those two organizations have given consideration to the question of map-making by airplane photographs. It is hoped that airplane surveying can be developed at least to supplement the usual surveyor's methods in mapping the interior on a comparatively large scale map with high accuracy.

It would appear that if the airplane photograph will be of so much assistance in the topographic work along the shores of the country that it would really be of some value in the interior.

Whether or not it is possible to locate contours from airplane photographs is a question that has not yet been decided. Many persons who have studied the question claim that it is impossible to locate contours accurately from airplane photographs. Others claim that they can be located with great accuracy. The substance of the situation is probably this: it will be possible later to devise methods of contouring from photographs provided that we can solve one or two of our present more fundamental problems. It is possible that the stereoscopic method can be applied to two photographs taken by two cameras on the same airplane or by cameras on two different airplanes together to obtain a rough idea of the configuration of the country.

SURVEYING THE INTERIOR OF THE COUNTRY

With regard to surveying the interior of the country for the purpose of making an accurate large scale, contoured map, I may say that here the airplane photographs can undoubtedly supplement the usual surveying methods, but can not entirely supplant them.

Such a map should probably be on a 1/50,000 scale, that is one foot on the map would equal 50,000 feet on the ground, and the distance between control points on the opposite edges of the area of a map should be correct within about 1 part in 10,000. The only method by which this can be accomplished is by triangulation and transit and tape traverse. The method to-day is to establish the triangulation and traverse stations ahead of the topographic surveying, with the geographic positions, that is latitudes and longitudes computed on the North American or final datum. When the control points are placed on that datum their positions will not have to be changed when two maps are joined.

The control, namely triangulation and traverse, bears the same relation to the topographic mapping of the country that the steel framework of a sky-scraper bears to the detailed portions of the building, such as walls, floors, doors, windows, etc. If the steel work is not accurately fastened and adjusted when erected, before the detailed portions are started on a building, it is reasonably certain that the building will be distorted in shape and will be structurally weak.

The same idea pertains to maps, and the difficulty mentioned actually exists to-day in some parts of our country, where the detailed mapping of certain areas had to precede the triangulation and traverse based on the North American datum. The result has been overlaps, gaps, offsets, etc., when two maps, based on different data have been joined together.

LATITUDES, LONGITUDES AND ELEVATIONS NEEDED

It is the province of the Coast and Geodetic Survey to extend the fundamental control, that is, latitudes and longitudes in long arcs throughout the country. These arcs are interlaced in order that the requisite strength may be obtained. This work has been carried on as vigorously as the funds at the disposal of the Survey would permit. We have arrived at a situation to-day which demands that this work be expedited, and it is hoped that Con-

gress will respond to our appeals for funds in order that the work may be carried on so rapidly that all mapping operations of federal, state, city, county and private organizations, may have their needs met. This is a very urgent matter and I shall do my utmost to persuade the authorities to give this branch of federal surveying ample support, in order that the country may be mapped more satisfactorily and more efficiently.

When this control is available in any area, the usual method is to have surveying parties in the field place the topographic features on the maps in their proper relation to the control points. Every object on the face of the earth has one, and only one position, and it is the duty of the surveyor to place that object, whether it is a road crossing, a bridge, the top of a hill, or any other object, in its proper position on the map. On the most exact map for military purposes a well-defined feature is placed on the map within thirty feet of its exact relation to the nearest control station. Other maps have larger allowable discrepancies.

The work involved in the topographic surveying consists not only in placing the features on the map in their correct horizontal positions, but also in showing by contours the lines of equal elevation, the slopes of the ground, the shapes of hills and the exact elevations of a number of critical points.

The elevations are based upon lines of levels run inward from the oceans. The surface of the ocean, if it were at rest, would be a continuous one, and thus the mean position of the surface serves as a datum plane from which to measure heights in the interior of the country. More than 40,000 miles of the highest grade leveling has already been established in the interior of the country, and there are more than 20,000 precise leveling bench marks whose elevations are known within a very small portion of a foot.

In addition to the above there are many thousands of miles of leveling of a lower grade of accuracy which is used for the immediate control of the topographic surveying.

It is the duty of the Coast and Geodetic Survey to extend the lines of precise leveling into the interior of the country for the purpose of furnishing starting points for the leveling needed for the immediate use of the surveyor and engineer. What has been said in regard to the fundamental horizontal control is also applicable to the precise leveling. Many more thousands of miles of this grade of leveling are needed in the United States to-day and it is hoped that the bureau may be given the support necessary to complete within the next few years the work which is now needed and should have already been done.

TOPOGRAPHIC SURVEYING WITH PLANE TABLE

The topographic surveying is done generally by means of the plane table which consists of a tripod with certain fixtures and a plane board mounted thereon. The board is approximately 24×30 inches in horizontal dimensions. On this board is placed a sheet of paper on which the topographical features are shown. On the paper there will have been placed before going to the field, the positions of the control points, and with these as starting points, the topographer weaves a net showing the various features of the earth's surface by means of symbols. These symbols have been standardized by the map users of the United States. Any one wishing to utilize the information given by one of the high-grade maps, should be thoroughly familiar with these symbols.

As far as present development of airplane photography is concerned, it seems absolutely necessary in making the contoured survey, to do the work with the present methods. One can readily understand that it would be impossible to show contours at intervals of twenty feet over a wooded area, where trees in different parts of the forest varied in height. The area photographed will not show the differences of elevations of trees in a wood, for the low trees and bushes not more than twenty feet in height, would show about the same on a photograph as a primitive forest where the trees may be seventy to one hundred feet high.

ENGINEERS NEED ACCURATE MAPS

The contoured map must be of such accuracy as to enable the highway engineers, and engineers engaged on irrigation projects, to lay out their work accurately. It can be readily seen that with an accurately contoured map, the engineer can plan the railway, the highway, etc., from one place to another, and not make great mistakes in grades and alignment. It is doubtful if, even after considerable research work, airplane photography would ever produce a map contoured accurately enough for such engineering work. It is of course possible that some method may be discovered by which the differences in elevation between two points shown on each of two separate photographs can be computed, but if one considers that the work involved, if it can be done at all, will be very great, he will see that it will probably be more economical to put the contours on the map by the usual methods, than to compute innumerable elevations from photographs.

The possible method of computing distances and elevations from photographs may be supplemented by using the stereoscopic method which would give one an idea of the configuration of the ground. This would enable the draftsman in the office to select critical points whose elevations could be determined. Such critical points would be crests of hills or ridges and the bottoms of slopes. If the elevations of critical points are determined then contours could be interpolated between them.

I am giving these statements with a good deal of reservation on my part, for the method of contouring by airplane photography has not been developed and it may be that very little can be accomplished where accurate contouring is desired. Investigation has not yet been carried to the point where one can state definitely the possibility or impossibility of contouring by this method.

AIRPLANE SUPPLEMENTS PLANE TABLE

But this accurate large-scale contoured map can undoubtedly be made by combining the usual methods of surveying with the aero-photographs. The aero-photographs will usually give a great deal of detail which may facilitate the progress of the map by the topographer using the plane table. It will be necessary of course for the topographer to select a number of definite points on his map, such as road crossings, large buildings, groups of buildings, bridges and other features which can be identified from the photographs. Those features would serve as control points for the topographic details shown on the photographs. Without such points located by the usual methods, it would be necessary to place certain conspicuous objects on the ground near the triangulation and traverse stations. Almost any kind of object that would show in the photograph, and have a distinct shape, could be used. But the placing of these objects would be expensive. It is believed that the location of the conspicuous features referred to above could be done by the topographer at a much smaller cost than the cost of placing objects for the aero-photographs, at the triangulation and traverse stations.

It is possible that the topographer would be able to place the topographic details on his map from the photographs before going into the field to do the contouring. Much of the work of the topographer by the usual methods consists in placing the topographic features on the map in their proper location, but a great deal of this might be obviated by the use of the photographs. Then he could go into the field and place the contours with greater rapidity than if he attempted to do so previous to using the details of the photographs.

AIRPLANE VALUABLE FOR MAP REVISION

What I have stated above in regard to original surveys by aero-photography, in the three classes of high-grade maps, are simply opinions or prophesies. These are the coast charts, the contoured maps of the interior, and maps which show all features except contours, but I feel confident in stating that even on the highest grade of topographic maps, the aero-photographs can be used to a great degree in revising and bringing up to date maps of that character which have already been made. Let us suppose that we have be-

fore us a topographic map made by the U. S. Geological Survey, say ten years ago, and let it be supposed that this map, at the time it was made, was absolutely perfect. The map is supposed to show the contours, woods, streams, houses and other features that are usually represented on such a map. In the ten years since the map was made, it is reasonably certain that some changes have been made by the works of man. It is improbable that natural features would have changed, such as streams, woods and hills, during such a short period. We may assume that new roads have been made, old buildings torn down, or burned, and new ones erected, that wooded areas have been cleared, and that brush or young trees may now be on areas that were bare at the time the original survey was made. In order to test such a map and learn whether it was up to date, it would be necessary by the usual methods, to send a surveyor into the field to go over the area in great detail. Of course an inspection could be made of an area by driving over it, but many changes might be overlooked by this method of inspection.

How much simpler and more reliable it would be to send an airplane over the area in question and make a series of photographs. These photographs would show at a glance, the exact areas where changes in the features had occurred, and if the changes were not too complicated it is probable that we would be able to place the new features on the map directly from the photographs. The process would be to fit in the new features between unchanged old features, which of course would also be shown on the photographs.

PHOTOGRAPHIC PLATE SHOULD BE HORIZONTAL

In what has been said above, it has been assumed that the photographs have been made with the camera vertical, or, in other words, with the photographic film or plate in a horizontal position. It is only in this way that absolutely accurate photographs could be made. If the camera is tilted from the vertical at the instant the exposure is made, then there will be a distortion of the photograph so far as the map is concerned. If this tilting were known, then the photograph could be rectified and the features shown on the map with the same accuracy as if the plate had been horizontal at the time of the exposure.

It is hoped that methods will be developed for holding the camera in a vertical position at the time of exposure. I know of none now in use which is entirely satisfactory.

CONCLUSION

I may conclude that airplane surveying can be done now and it undoubtedly has a bright future. Much experimentation must be done, however, before the airplane can be used extensively in high-grade work.

I feel that the airplane can now furnish maps of a low order of accuracy so far as scale and position of features are concerned, which will be of considerable value in many branches of industry and commerce. They will undoubtedly be extensively used in unmapped areas in this and other countries in the very near future, for reconnoissance surveys and maps. But I hope they may be of great use in more accurate work.

I can pledge the Coast and Geodetic Survey, so far as its limited resources will allow, to take its part in making such tests by airplane as may be feasible in connection with surveying and mapping.

E. Lester Jones
U. S. Coast and Geodetic Survey

TRAINING IN SUGAR TECHNOLOGY IN HAWAII

Hawaii leads the world in her applications of science to the production of cane sugar. In no other country is the cultivation of cane so highly developed, the extraction so high, the chemical control so thorough, the mill processes so accurately coordinated. The entire organization of Hawaii's sugar industry is unparalleled for business efficiency and scientific control.

The experiment station of the Hawaiian Sugar Planters' Association is recognized throughout the world for the high quality of its investigational work. Its resources are

large, varied and unique. It has a large staff of trained research men, working in the various branches of sugar production.

The College of Hawaii has a standard four-year course in sugar technology. The College of Hawaii is the territorial college of agriculture and the mechanics arts. It corresponds in general status and organization to the state colleges and universities of the mainland. A number of its graduates are now actively engaged in the sugar industry.

The Courses in Sugar Technology are designed primarily for the student who, on leaving college, intends to enter into active service in some branch of the sugar industry. Although these courses, since they prepare for one particular industry, might be termed highly specialized, the importance of a sound training in general science has not been overlooked, the first two years being devoted largely to English, mathematics, physics and chemistry.

In the third and fourth years, enough special instruction in subjects pertaining directly to the sugar industry is given so that the man who completes this course should have sufficient technical understanding to prove of some immediate value in a subordinate position on a plantation, and yet not have his future progress hampered by an inadequate theoretical training.

The cane sugar industry, as carried on in the tropics, comprises in itself two quite distinct branches; the growing of cane, and its manufacture into sugar. Inasmuch as it would be extremely difficult, if not impossible, to give thorough instruction in both these branches, in four years, the courses in sugar technology are offered in two divisions.

Agricultural Division.—The first two years are identical with the course in agriculture. In the third year quantitative analysis and organic chemistry are taken up in addition to strictly agricultural topics, for the reason that sugar production is probably more dependent on chemistry than is any other branch of agriculture. Sugar analysis is also required, as familiarity with this work is often required of a field chemist. The fourth year allows a liberal amount of electives to those students who wish to specialize in some one subject. The lectures on cane sugar manufacture are required in this year, as it is desirable that the agriculturist have some knowledge of what happens to the cane after he has grown it.

Engineering Division.—The first year is identical with the course in engineering, while the second year differs only in the substitution of qualitative analysis for advanced mechanical drawing. Chemistry is continued in the third year, together with the most essential of the engineering subjects. Students in this division take sugar analysis and sugar manufacture together with those of the agricultural division.

During the summer vacation between the third and fourth years a minimum of eight weeks' work on one of the plantations, or in connection with the work of the experiment station of the Hawaiian Sugar Planters' Association, is required of students in both divisions. To obtain credit for this, a written report of work performed is required.

The second semester of the fourth year is devoted almost entirely to practical work. Arrangements are made whereby students either serve *a special apprenticeship* on a plantation where under direction they actually perform the manual labor required at the various stations of the mill and boiling house, or else they work as assistants to men carrying on the experimental field work of the experiment station.

Students are required during this apprenticeship to take careful notes of the equipment necessary, time required and labor involved in each operation, and will meet at stated times for discussion and comparison of notes, with a view toward fixing the relationship between the theoretical principles previously studied and their practical application.

COOPERATION BETWEEN COLLEGE AND STATION

An important agreement has been effected recently between the college and the sugar planters' station, the essential points of which are as follows:

1. The station accepts College of Hawaii students in sugar technology, for a 2–3-month period during the summer, or for a 4-month period during the winter and spring. These students serve in the capacity of assistants to the field research men of the station.

2. These student assistants are appointed by the college. The college receives reports from the students, but publication rests with the station director.

3. The station pays each student assistant $45.00 per month, and pays actual transportation expenses while traveling on station work.

4. The program of work for the student assistants is of a practical nature, but with due regard to the educational features involved. The president of the college cooperates in arranging the program.

Under the provisions of this agreement, College of Hawaii students in sugar technology have remarkable apportunities and facilities for first hand familiarity with Hawaii's sugar industry.

Vaughan MacCaughey
College of Hawaii

SCIENTIFIC EVENTS

LOAN EXHIBITION OF EARLY SCIENTIFIC INSTRUMENTS AT OXFORD

The Classical Association held its annual meeting at Oxford on May 16–17, and Sir William Osler delivered the presidential address on "The Old Humanity and the New Science." We learn from *Nature* that on May 16 Sir William opened a loan exhibition of instruments and manuscripts illustrating the scientific history of Oxford from the fourteenth to the eighteenth century. The greater part of the instruments now shown have never been publicly exhibited before. They have been unearthed in cupboards and corners of libraries of colleges and university departments. They are, for the most part, in their original state and of corresponding historic value.

The two earliest dated Persian and Moorish astrolabes, A.D. 987 and A.D. 1067, lent by Mr. Lewis Evans, form a worthy introduction to a wonderful series of instruments lent by Merton College. One of these is traditionally associated with Chaucer, and another of the Saphea type is considered by Mr. Gunther to have been the instrument left by Simon Bredon either to the college or to its great astronomer, Rede, early in the fourteenth century. The energies of these early astronomrs were largely directed to the preparation of astronomical tables, which had a wide circulation, and Oxford was regarded very much as Greenwich is now.

The later astronomical exhibits illustrate the instrumental equipment of the Earl of Orrery, who must have been acquainted with the first members of the Royal Society. Many of his instruments are still in the state in which he left them to Christ Church. His telescopes of 8 feet, 9 feet and 12 feet focal length, with many-draw vellum tubes and lignum vitæ lens-mounts by Marshall and Wilson, form a unique series.

There is also a Marshall microscope of 1603 in excellent condition, as well as some magnificent planetaria and other astronomical models by Rowley, the maker of the original Orrerv.

The slide-rule of 1654 in the South Kensington Museum, must now yield to an instrument lent by St. John's College, dated 1635. It is in the form of a brass disc 1 foot 6 inches in diameter engraved with Oughtred's circles of proportion. Would space permit, the series of volvelles or calculating discs showing the age of the moon from manuscripts of the fourteenth and fifteenth centuries, and some early surveying instruments, are worthy of more particular description, as well as many other treasures now shown to the public for the first time. A printed catalogue of the principal exhibits, prepared by Mr. Gunther, of Magdalen College, is published by the Clarendon Press.

A NATIONAL POLICY OF FOREST PRESERVATION

The first of a series of regional conferences planned to consider special conditions in various sections of the country, so that a comprehensive national policy of forest preservation may be formed, was held May 20 in the United States Department of Agriculture. After for-

est problems of New Jersey, Maryland, Virginia and West Virginia had been discussed by representatives of those states and the Forest Service of the Department of Agriculture the following resolution was presented by Colonel Eugene C. Massey, former member of the Virginia state legislature, and was adopted:

> Forestry questions are national questions as well as state and local questions, and it is the sense of this conference that the national government should assume leadership in these matters and aid and cooperate with the several states in furnishing adequate protection from forest fires, in perpetuating existing forests, and in reforesting devastated forest districts or regions, upon such conditions as may seem just and necessary.

Some of the delegates suggested that the federal government should cooperate with the states in forestry work on lines similar to those prescribed in the federal aid road act and the Smith-Lever Act providing for agricultural extension work, and should make appropriations, to be matched by the states.

Among those attending the conference were: F. W. Besley, Maryland State forester, Baltimore; Dr. A. F. Woods, president, Maryland State Agricultural College, College Park, Md.; W. McCulloh Brown, member Maryland State Board of Forestry, Oakland, Md.; Alfred Gaskill, New Jersey conservation commissioner, Trenton, N. J.; R. Chapin Jones, Virginia state forester, Charlottesville, Va.; A. B. Hastings, assistant Virginia state forester, Charlottesville, Va.; Eugene C. Massie, former member of Virginia legislature, Richmond, Va.; Edwin P. Cox, member of Virginia State Geological Commission, Richmond, Va.; Nat T. Frame, state director of agricultural extension, Morgantown, W. Va.; H. S. Vandervort, assistant state agent, Morgantown, W. Va.; W. Hoyt Weber, representing Central West Virginia Fire Protective Association; W. D. Tyler, Dante, Va.; F. L. Dakin, Philadelphia, Pa.; P. S. Ridsdale, American Forestry Association, Washington, D. C.; David T. Mason, Bureau of Internal Revenue, Washington, D. C.; and a number of representatives of the Forest Service of the United States Department of Agriculture.

The second conference of the series is to be held in Asheville, N. C., June 4, for North Carolina, Tennessee and Kentucky.

PUBLICATIONS OF THE AMERICAN MEDICAL ASSOCIATION

Dr. Frank Billings in reporting for the board of trustees at the Atlantic City meeting of the American Medical Association stated that the increase in subscriptions of the *Journal* of the association for the year 1918 was small—229 all told—but this under the circumstances must be regarded as satisfactory. The weekly circulation during the first four months of the current year was greater than that in any previous four months, averaging over 70,000. The foreign circulation was also steadily increasing. The advertising standard of the *Journal* had been maintained, or, if anything censorship had been more rigid. The wisdom of establishing the Cooperative Medical Advertising Bureau became more evident each year. This bureau had demonstrated that it was possible to secure for the state journals a fair amount of advertising of which the profession need not be ashamed. The bureau began this year with twenty-six state journals; the only state journal not represented was that of Illinois. The *Archives of Internal Medicine* had been conducted at a loss, while the *American Journal of Diseases of Children* showed a small profit. The Spanish edition of the *Journal* was now issued on the first and fifteenth of each month and contained practically all the scientific material in the regular edition but matter that was ephemeral or of local interest was not included. The subscriptions were coming in rapidly and at present it had a circulation of 1,400. In response to a petition signed by a large number of leading neurologists and psychiatrists the *Archives of Neurology and Psychiatry* had been established. It was published on the same terms as the *Archives of Internal Medicine*. This journal might already be regarded as a success. It was of the highest order, a credit to American medicine, and to the association. It was to be emphasized that the association was not publishing these journals for financial gain; its sole ob-

ject was to advance scientific medicine and to benefit the American medical profession. The board of trustees was of the opinion that the association should publish more of these special journals if, and when, there was a call for them. Both the American Medical Directory and the Quarterly Cumulative Medical Index showed the effects of the war and had been published at a considerable loss. The house of delegates approved a motion providing that the publication of a *Journal of Surgery* be considered and also the publication of a *Journal of Medicine* for lay readers, if the house found such a procedure advisable.

THE RAMSAY MEMORIAL FUND

A meeting of subscribers to the Ramsay Memorial Fund was held on June 5, at University College, London, for the purpose of considering plans to be submitted by the executive committee with respect to the progress of the fund and to the objects to which the fund should be devoted. The total amount already given or promised amounts to £42,794 10s. 9d. This sum includes the following contributions by the following overseas committees: Switzerland, £817 6s. 9d.; United States of America, £626 15s. 10d.; Japan, £500 9s. 2d.; India, £397 8s. 4d.; Italy, £395 16s. 8d.; Denmark, £225; Norway, £186 6s. 7d.; Chile, £128 6s. 8d.; Holland, £68 1s. 7d.; Australia, £37 16s.; New Zealand £21 3s. 6d. It also includes £5,177 18s. 6d. collected by the Glasgow committee for a Glasgow fellowship. Promises, either provisional or definite, for the foundation of one, or more than one, Ramsay Memorial Fellowship have been received from the governments of Italy, Japan, Spain, Norway, China and Greece and other governments have the matter under favorable consideration.

More recently the committee of the Ramsay Memorial Fund for the United States reports the receipts of contributions totalling $4,700, which after deduction of current expenses for printing, postage, etc., will leave about £900 for transmission to the fund headquarters in London. The committee had hoped to be able to transmit at least £1,500 at this time, and will therefore welcome further contributions. Checks should be sent to the chairman, Dr. Charles Baskerville, 140th Street and Convent Avenue, New York, or to the treasurer, Mr. William J. Matheson, 21 Burling Slip, New York.

SCIENTIFIC NOTES AND NEWS

At the meeting of the American Medical Association held in Atlantic City last week, Surgeon-General W. C. Braisted was elected president. The meeting next year will be in New Orleans. Other officers of the association were elected as follows: *First Vice-president,* D. L. Edsall, Boston; *Second Vice-president,* Emery Marvel, Atlantic City; *Third Vice-president,* Eugene S. Talbot, Chicago; *Fourth Vice-president,* George H. Kress, Los Angeles; *Secretary,* Alexander R. Craig, Chicago; *Treasurer,* William Allen Pusey, Chicago; *Speaker of House of Delegates,* Hubert Work, Pueblo, Colo.; *Vice-speaker,* Dwight H. Murray, Syracuse, N. Y.; *Trustees,* Archibald Dowling, Shreveport, La., A. R. Mitchell, Lincoln, Neb., D. C. Brown, Danbury, Conn.; *Judicial Council,* Ira C. Chase, Ft. Worth, Tex.; *Council on Health and Public Instruction,* Haven Emerson, New York City; *Council on Medical Education,* Arthur D. Bevan, Chicago; *Council on Scientific Assembly,* J. B. Blake, Boston.

The eighty-seventh annual meeting of the British Association will be held in Bournemouth from September 9 to 13, under the presidency of the Honorable Sir Charles Parsons, who will deliver an address dealing with engineerng and the war. The following presidents of sections have been appointed by the council: A, Mathematical and Physical Science, Professor Andrew Gray; B, Chemistry, Professor P. Phillips Bedson; C, Geology, Dr. J. W. Evans; D, Zoology, Dr. F. A. Dixey; E, Geography, Professor L. W. Lyde; F, Economic Science and Statistics, Sir Hugh Bell, Bart.; G, Engineering, Professor J. E. Petavel; H, Anthropology, Professor Arthur Keith; I, Physiology, Professor D. Noel Paton; K, Botany, Sir Daniel Morris; L, Educational Science, Sir Napier Shaw, and M, Agriculture, Professor W. Somerville. Evening discourses will be delivered by Sir Arthur Evans on

"The palace of Minos and the prehistoric civilization of Crete"; and by Mr. Sidney G. Brown on "The gyroscopic compass."

THE American Institute of Electrical Engineers holds its thirty-fifth annual convention at the Lake Placid Club, Lake Placid, New York, from June 24 to 27. The annual presidential address by President Comfort A. Adams will open the convention on Tuesday morning and will be followed by the introduction of President-elect Calvert Townley.

FELLOWS of the Royal Society have been elected as follows: Professor F. A. Bainbridge, Dr. G. Barger, Dr. S. Chapman, Sir C. F. Close, Dr. J. W. Evans, Sir Maurice Fitzmaurice, Dr G. S. Graham-Smith, Mr. E. Heron-Allen, Dr. W. D. Matthew, Professor C. G. Seligman, Professor B. D. Steele, Major G. I. Taylor, Dr. G. N. Watson, Dr. J. C. Willis and Professor T. B. Wood.

DEAN VICTOR C. VAUGHAN, of the University of Michigan, was elected the first president of the Medical Veterans of the World War organized at the recent meeting of the American Medical Association.

THE British government has conferred upon Major General Ireland the Cross of Companion of the Bath in recognition of his services as chief surgeon of the American Expeditionay Forces and later, as Surgeon-General of the American Army.

THE Cullum geographical medal of the American Geographical Society has been awarded to M. E. de Margerie, known for his work on physical geography.

SIR J. J. THOMSON, master of Trinity College, Cambridge, and president of the Royal Society, and Sir Norman Moore, Bart., president of the Royal College of Physicans, have been elected to the standing committee of the British Museum.

MAJOR RESTON STEVENSON, who has been working for the French government in the Chemical Warfare Service, has recently returned from France. He has been discharged from the Army, and will return to the department of chemistry of the College of the City of New York to continue his work there.

CAPTAIN PAUL E. HOWE, Sanitary Corps, has received his discharge from the Army and has resumed his work at the Rockefeller Institute, at Princeton, N. J. For several months, Captain Howe was nutritional officer at Camp Kearny, California. Later he was recalled to Washington to work out plans for a course in food and nutrition at the Army Medical School. A food laboratory has been planned and is now partially equipped for use in connection with this course and for making food analyses for the Medical Department of the Army.

PROFESSOR L. C. GRATON, who had recently returned to the Harvard geological department from work on one of the war committees in New York, has been called to Washington for the next year to establish principles of copper mine valuation and depletion for the Income Taxation program under the Treasury Department.

MR. L. E. WARREN has resigned as chief research chemist for Wm. R. Warner & Co., of New York City, and has accepted a position as associate chemist in the laboratory of the American Medical Association in Chicago.

MR. ELIOT BLACKWELDER has resigned his position as professor of geology at the University of Illinois. After September 1 he will devote his time largely to geologic research, especially regarding the history of the Rocky Mountains, with headquarters at Denver.

DR. E. D. ROE, JR., John Raymond French professor of mathematics at Syracuse University, has been elected director of the observatory. His position in the department of mathematics remains unchanged.

PROFESSOR ROLLIN D. SALISBURY, head of the department of geography and dean of the Ogden Graduate School of Science at the University of Chicago, has been appointed a member of the Illinois State Board of Natural Resources and Conservation, to succeed Professor T. C. Chamberlin, head of the department of geology.

IN the list of members of divisions of the National Research Council published in the May 16 number of SCIENCE, under the Divi-

sion of Biology and Agriculture, Botanical Society of America, the name of A. S. Hitchcock was omitted.

Information has been received from Dr. L. A. Bauer that the observations made by his party at Cape Palmas, Liberia, during the total solar eclipse of May 28–29, were successful.

Dr. Walter Hough left Washington in May for Arizona, to conduct ethnological and archeological explorations in the White Mountain Apache Reservation for the Bureau of American Ethnology.

Mr. Charles M. Hoy, of the National Museum, has left for Australia, to collect animals and other biological material for the museum.

Professor W. H. Twenhofel, of the University of Wisconsin, and a party of six students, five from the University of Wisconsin and one from Yale University, will devote the summer of 1919 to a study of the geology of Anticosti Island, Gulf of St. Lawrence. The party will leave Madison about June 20 and expects to return about October 1.

Professor J. Paul Goode, of the University of Chicago, gave the final address of the year's program of luncheon meetings of the Civic Industrial Section of the Association of Commerce of Chicago, in the ball room of the Morrison Hotel Thursday, May 29. The subject of the address was "America as a world power."

Major A. O. Leuschner, acting chairman of the Division of Physical Sciences, National Research Council, delivered an address on "The determination of the orbits of comets and planets" before the Washington Academy of Sciences on May 27.

The Croonian lecture of the Royal Society was delivered on May 29, by Dr. H. H. Dale on "The biological significance of anaphylaxis."

The Halley lecture was delivered by Professor Horace Lamb at the University of Oxford Museum, on May 20. The subject was "The tides."

The Association for the Advancement of Laboratory Science among Women will offer through Dean Carey M. Thomas, of Bryn Mawr College, who is about to leave for France, $2,000 to Mme. Curie to come to the United States in 1920–21 to lecture in women's colleges and in other institutions.

Nature records the death of Dr. Milan Stefanik, formerly attached to the Meudon Observatory. In 1906 he went, with others of the staff, to the subsidiary observatory at Mont Blanc, where he continued his study of the infra-red from the point of view of telluric absorption, making his observations from different altitudes on the mountain. In 1910 Dr. Stefanik established at his own expense an observatory in the island of Tahiti to pursue his researches, and was therefore conveniently placed to observe the solar eclipse of April 28, 1911. Dr. Stefanik became a general in the French army, and met his death at a comparatively early age in an aeroplane accident in a flight from Italy to Bratislava, the capital of his native land of Slovakia.

The death is announced of Sir Edward Charles Stirling, F.R.S., of Adelaide, South Australia, the explorer and ethnologist.

Colonel D. Rintoul, senior science master and head of the physics department of Clifton College, died on April 21, of pneumonia, at the age of fifty-seven years.

The Okefinokee Society, recently organized for the purpose of bringing about the preservation for scenic and scientific purposes of Okefinokee Swamp and other natural wonders in the southeastern United States, held its first meeting at Waycross, Georgia, on June 3. This was followed in the evening by an illustrated public lecture on Okefinokee Swamp by S. W. McCallie, state geologist of Georgia, and a trip to the swamp by visiting members the next day. The society desires the cooperation of botanists, zoologists and nature-lovers throughout the country. Those who have not already been communicated with can obtain a copy of the constitution and other information by addressing the secretary, Dr. J. F. Wilson, Waycross, Georgia.

Two thousand and five hundred delegates from farmers' organizations in Washington, Oregon and Idaho in session at Seattle on June 13 subscribed $20,000 toward a fund for building a temple of agriculture in Washington, D. C.

UNIVERSITY AND EDUCATIONAL NEWS

THE sum of £200,000 is being provided by the Victorian government to enable Melbourne University to complete its buildings.

THE Goldsmiths' Company has given £5,500 to the University of Cambridge for the purpose of extending and equipping the department of metallurgy.

DR. LEVERETT D. BRISTOL has been elected dean and professor of bacteriology and public health of the University of Tennessee College of Medicine at Memphis.

DR. L. J. GILLESPIE, of the Bureau of Plant Industry, has been appointed professor of physical chemistry in Syracuse University.

FREDERICK RASMUSSEN, who has been appointed Pennsylvania state secretary of agriculture, has been succeeded in the professorship of dairy husbandry at the Pennsylvania State College by Andrew A. Borlaw, of the extension department.

AT the University of Chicago John A. Parkhurst, of the department of astronomy and astrophysics and Elbert Clark and George W. Bartelmez, of the department of anatomy, have been promoted to associate professorships.

PROFESSOR C. R. MARSHALL, professor of materia medica and therapeutics, in the University of St. Andrews has been appointed Regius professor of materia medica in the University of Aberdeen, vacant by the resignation of Professor Theodore Cash.

DR. BOON, has been appointed to the chair of chemistry at Heriot-Watt College, Edinburgh.

MR. R. W. H. HAWKEN has been appointed to succeed Professor A. J. Gibson as professor of engineering in the University of Queensland.

DISCUSSION AND CORRESPONDENCE

THE VALLEY OF TEN THOUSAND SMOKES

UNDER the caption "The Katmai National Monument" in the issue of SCIENCE, January 3, several observations and comparisons are made relative to this wonderful natural phenomenon. Among these occurs the following:

> Rock strata superheated since the great eruption underlie Katmai near enough to the surface to turn to instant steam the spring and drainage water of many a surrounding mile of foot hills. Thus originates the steam which bursts from the myriad valley vents.

An acquaintance with this remarkable volcanic area would convince the writer of the above observations that his explanations are quite inadequate to explain the phenomena occurring there and an examination of the gases evolved would still further convince the writer that he was dealing with something much more closely related to the molten magma than an area of residual superheated strata—presumably so heated in 1912 and slowly cooling off. Although steam is the principal constituent of the emanations yet there are many vents in which steam is but a small percentage of the issuing gases, the main portion of the vapors being highly corrosive acids, volatile metallic chlorides, sulphides and oxides.

It is quite true that the local surface drainage disappears as it attempts to find its way down the valley and some of the lesser conspicuous features of this valley are dumps of volcanic débris vomited out from the throats of vents into which the surface storm drainage had poured it. But the most active area of the whole valley lies right on the peninsular axis itself and no one seeing the vast quantities of vapors being evolved would for a moment consider their origin to have been up-grade surface infiltration from the distant "foot-hills."

The peninsular axis is not yet in equilibrium with the volcanic forces. In 1917 avalanches of rocks were being precipitated down the perpendicular face of Falling Mountain. Gases were issuing from crevices distributed from the bottom to the top 2,000 feet above

the level of the valley. Fifteen miles to the eastward a similar disintegration of a mountain in the peninsular axis was taking place but without the accompanying gaseous emanations. It is reasonable to assume that this axial disturbance is attributable to slow upthrust due to volcanic pressure from the underlying magma.

It is somewhat difficult to reconcile the idea of a cooling-off mass of material such as lies on the slope of Mount Lassen as the origin of the activity in the Valley of Ten Thousand Smokes. The activity is too pronounced, too constant and too evidently magmatic to admit of any explanation other than the direct volcanic origin of the gases. This valley is just as truly volcanic to-day as are the craters of Vesuvius and Kileaua. The superficial liquid lava alone is absent.

The character of the gaseous emanations points to their magmatic origin. I found that the gases as they issued were not in chemical equilibrium but continued to react after being collected, the total volume increasing. Moreover, these gases far from being spent products of volcanic action contain some of the most chemically active gases found issuing from any volcano on the face of the globe. The secondary products of these gases, that is the sublimates, etc., formed by their action on the rocks through which they pass to the surface are of a kind and quantity found only in the most active volcanic areas. Dikes of volcanic sublimates and incrustations several feet high and hundreds of yards in length mark the outlet of these subterranean emanations.

There are huge tunnels running horizontally beneath the surface of the mud flow, tunnels formed by the solvent action of the issuing gases. At the upper end of the valley seventy-five feet below the surface is a horizontal tunnel large enough to drive a team and wagon through. There are no incrustations on the walls of this passage but they are baked a brilliant brick red. It is only near the surface that the cooling off of the gases permitted the deposition of incrustants on the walls of the vents, and even here the temperature is at times so high—several hundred degrees centigrade—that little matter is deposited and the gases only become visible several feet above the opening of the vent.

Gautier[1] shows that a cubic mile of granite if forced to give up its aqueous content, as by fusion, would release 100,000,000 tons of water. Another 20,000,000 tons would be supplied if the hydrogen contained in this mass of rock could be burned. Water at a high temperature and under pressure reacts actively with other compounds that are not appreciably affected by it at ordinary temperatures. Barus[2] found that at 210°, 50 grams of water dissolved over 200 grams of glass. With carbon dioxide it forms carbon monodixe, hydrogen, methane and free carbon. It decomposes metallic sulphides and no doubt reacts upon other compounds of the metals. Should it be dissociated into its elements as is quite possible at the temperature obtaining within volcanoes then it becomes at one and the same time an oxidizing and reducing agent of the strongest character.

A better explanatory postulate for the phenomena of the Valley of Ten Thousand Smokes is afforded by considering the origin of the gaseous emanations to be that of the chemical reaction between the water content of the crust in contact with the heated magma, and the secondary reactions consequent upon the chemical activity of the water under these conditions, gives rise to the variety of gases and sublimates found issuing from the surface vents. The explosion of June, 1912, may have ruptured the sedimentary rocks underlying the valley and permitted these gases to escape through the crevices so formed or a subsidence of the valley floor may have precipitated a mass of the crust into contact with a region sufficiently hot to fuse the rocks. The pressure of the gases so formed may have caused the explosion wrecking Katmai and the floor of the valley itself. There is little doubt but that the activity is far from subsiding for

[1] *Compt. Rend.*, Vol. 143, 1906.

[2] *Am. Jour. Sci.*, Vol. 9, 1900.

Falling Mountain in 1917 was still reacting from subterranean pressure and another mountain fifteen miles to the eastward was also sending down avalanches of rocks. The presence of the lava plug Novarupta upthrust 200 feet above the floor of the upper end of the valley in 1912 is another bit of evidence that the activity of the valley is not of a secondary nature.

No other volcanic region in America offers such an opportunity for the study of the products of volcanic activity as does this. The vents are easily approachable, the gases are issuing under pressure and are not in equilibrium, the salts within many of the vents are anhydrous due to the high temperature of the issuing gases. Sublimates are in evidence every where. The valley will be a fertile field of investigation alike for the geophysicist, geologist, chemist and mineralogist. It is to be hoped that the preliminary work already commenced will be prosecuted vigorously so that nothing will be lost through the lapse of time.

The setting apart of this valley as a national monument is a fitting climax to the expeditions of the National Geographical Society and to the persistent and untiring efforts of Dr, R. F. Griggs, director of the Katmai explorations.

J. W. SHIPLEY

WINNIPEG, MAN.

QUOTATIONS

THE CONDITIONS ATTACHED TO GOVERNMENT GRANTS FOR SCIENTIFIC RESEARCH IN GREAT BRITAIN

MAY I again direct attention to the conditions under which grants are made to individual research workers by the Committee of the Privy Council for Scientific and Industrial Research (London: H.M. Stationery Office, 1919. Price £6)? The matter is of some importance, as not only are those who refuse to accept these conditions debarred from participating in the grants made from the public purse for scientific research, but other sources which used to be available, and to which such conditions were not attached, are also being cut off. I understand, for example, that the Carnegie Trust for the universities of Scotland intends very largely in the future to discontinue its grants in aid of research, and to refer applicants to the government.

By accepting a grant under these conditions, a research worker undertakes not to publish his or her results without the consent of the committee, and gives up the ownership in the commercial rights of his discoveries, which otherwise, under the patent law, belong to him. It is the committee, not the inventor or discoverer, that is to determine to what extent and in what proportion the committee and those who have made the discoveries are to secure the ownership of the results by patent, presumably on the ground that the committee has provided the funds for the research. If that is the ground, ought not the committee to state precisely what is the share it claims, whether the share is limited to the amount of the monetary contribution, or if it intends to make a profit? I understand the money was given by Parliament to foster research, not to exploit it. As it is, a worker accepting a grant places himself absolutely, as regards the legal right to his own property, in the hands of a committee, and if, as is bound to occur, differences arise as to what is the share of the discoverer or who is the discoverer, the matter is not put into the hands of an impartial arbitrator to settle, but is settled by one of the parties in the dispute. In precisely the same way, with existing secret patents, if a dispute arises between a patentee and the government, it is the treasury, who pays for the use of the patent, that settles the dispute.

The condition is justified on three grounds. First, on the ground of national interest, especially in the present abnormal circumstances, and that it is not in the national interest that results of commercial value should be made available to other countries to the detriment of our own. As regards actual war conditions, patents containing any information likely to be of use to the enemy have not been published, so this is secured independently of the question of the ownership of the patent. As regards the future, one is justified in ask-

ing whether it is the intention of the committee that the results of researches obtained by the expenditure of national funds should be kept secret, as most scientific men would regard this as short-sighted.

The second ground is that, where results are to be patented, delay in publication is in the interest of the investigator. This is scarcely relevant. It is surely in the highest degree dangerous to delay applying for a provisional patent until the results have been communicated to the committee and its consent obtained, for any person who, by lawful or unlawful means, gets the information is then in a position to prevent the real discoverer from protecting himself.

The third ground is that it is the object of the department to secure to the discoverer a fair share in any profits that may accrue from his discovery. Admittedly, the class of inventors and discoverers is in very great need of being protected from the sharp practises that have sprung up under the shadow of the patent law, and primarily from the government itself. But why should a small part of them, who receive government funds, be singled out and protected? If the discoverer prefers to secure for himself the legal ownership of his discoveries, rather than from the committee, I do not think he should be debarred from participating in this money. The most, I think, the committee has a right to stipulate is that its interest is limited to the amount it has contributed, and that, in the event of a dispute, the matter shall be referred to an impartial arbitrator for settlement.—Frederick Soddy in *Nature.*

SCIENTIFIC BOOKS

Zoologica. Scientific Contributions of the New York Zoological Society. Volume I., 1907–1915, 436 pp. 8vo, with 138 illustrations. Published by the Society, The Zoological Park, New York.

In 1906, after the New York Zoological Society had advanced its two primary objects, namely, the establishment of a great zoological park and aquarium, it entered more seriously upon its third chief object—the promotion of zoology through exploration, research and publication. Two volumes have already been published, namely "Tropical Wild Life," studies from the Tropical Station of British Guiana, and "A Monograph of the Pheasants," Volume I., by C. William Beebe. The present volume is the third to be issued; it contains twenty bulletin papers which have been published by the society beginning in 1907, and here brought together in permanent form.

The members of the scientific staff of the park and of the aquarium did not enter the well-trodden field of the lifeless cabinet or museum animal, nor of the older systematic or descriptive zoology, nor even of the newer field of experimental zoology and Mendelism; they sought the inspiring field which has been relatively little entered in this country or abroad, namely, observation of the normal living bird and the living mammal, wherever possible in its own living environment, not from the standpoint of the older naturalists or systematists, but from the standpoint of the newer problems raised in modern biology. This is a path partly pursued by certain of the older naturalists and travelers, and especially by such wonderful observers as Darwin, Wallace and Bates, which has been abandoned for a time through the lure of artificial experiment and of the breeding pen, but which may now be followed with the new ardor of a larger knowledge of the problems and of a deeper insight into the search for natural causes. These causes are sought either in the experiments which nature herself is constantly trying, or in a close imitation of the actual experiments of nature, as in Beebe's studies of the causes governing the changes of plumage and of color in the scarlet tanager (*Piranga*) and the Inca dove (*Scardafella*).

The work of Beebe, contained in the opening article of the volume, entitled "Geographic Variation in Birds," describes his initial experiments and observations, which are continued in a later paper, "Postponed Moult in Passerine Birds." In brief it is the normal and natural phenomena which are being investigated. In midsummer he placed several

scarlet tanagers and bobolinks under careful observation. Little by little the supply of light was cut off and the amount of food was increased. In about a month, when the time for the normal autumn moult arrived, the tanagers and bobolinks were living the "simple life" in a dim illumination, and, although consuming a fair amount of food, were exercising but little. As the winter gradually passed, it was evident that the birds had skipped the autumn moult entirely and appeared to suffer no inconvenience as a result. In the following spring individual tanagers and bobolinks were gradually brought under normal conditions and into their seasonal activities, with quick result. The birds moulted into the colors appropriate to the season; there was no exception; the moult was from nuptial to nuptial, not from nuptial to winter plumage; the dull colors of the winter season had been completely suppressed. Of an entirely different character is Beebe's second paper, "A Contribution to the Ecology of the Adult Hoatzin," a bird which presents a most remarkable survival both of habit and structure in the presence of claws on its wing phalanges and in its tree-climbing habits.

Interspersed with the biological papers are some which are partly biological and partly systematic, such as Beebe's third paper, "An Ornithological Reconnaissance of Northeastern Venezuela." It was learned in the zoological researches of Venezuela and in the more recent work in British Guiana, at the Tropical Research Station, that a systematic survey of the zoology and botany of any region is absolutely essential for broad and intensive biological and experimental work. Thus there also appear in this volume the first series of systematic papers on the "Insects of British Guiana," by Kellogg, Caudell and Dyar; also "Notes on Costa Rican Birds," by Crandall. These will be followed in Volume II. of *Zoologica* by very complete check-lists of the birds and mammals of British Guiana, to which the Zoological Society observers have made very extensive additions.

Of more general zoological character of the older kind are Townsend's observations on the "Northern Elephant Seal," describing his discovery of a previously unknown herd on Guadalupe, an uninhabited island lying in the Pacific Ocean 140 miles off the northern part of the peninsula of Lower California. There is also a series of morphological papers, such as those of Beebe, on the "Supernumerary Toes in Hawks," and of Gudger, on "The Whale Shark." One pathological paper has found its way into this volume, namely, that of W. Reid Blair, entitled, "Common Affections among Primates." Other papers of this character, however, will be placed in the special pathological series to be issued by the Zoological Society. It is not intended to continue in these volumes of *Zoologica* such papers as MacCallum's "Ectoparasitic Trematodes," not because they are not of interest and value, but because they belong more properly with other series of researches.

Quite germane to this volume, however, are Ditmar's observations on the "Feeding Habits of Serpents," and Beebe's careful studies on the "Racket Formation in Tail-Feathers of the Motmots," which describe the rare phenomenon of the apparent voluntary mutilation of plumage of birds with its well known bearing on Lamarckism. We have known absolutely nothing of the actual cause of this phenomenon; either how it arose, why it is so persistent, or what good is accomplished. For some reason totally unknown to us a certain portion of the central rectrices of these birds exhibits congenitally a decided degeneration of the barbs and barbules; the motmot, in the course of the preening to which it subjects all of its rectrices, breaks off the enfeebled barbs in the area most affected by this degeneration, and thus brings about the remarkable, symmetrically formed rackets. Thus an apparently purposive act is explained as being due to the weakness or hereditary degeneration in a certain portion of the tail.

The Zoological Society thus puts forth its first volume of collected contributions by younger men who have been trained chiefly within its staff and by its expeditions on land and sea, in the hope of striking the new and inspiring note which normal life always gives.

Since the materials for this first volume were collected, the same authors have found especially in the wild life of South America and of Asia materials for these and for more profound and exhaustive studies which from time to time will be published in succeeding volumes of *Zoologica*.

The present work contains 436 pages and 138 illustrations. These collected papers are handsomely bound, for free distribution to certain of the libraries which exchange with the library of the Zoological Park, and for sale to other institutions. The volumes appear under the editorship of Henry Fairfield Osborn, president of the society, with the assistance of Elwin R. Sanborn, and may be purchased by application to the secretary of the Zoological Society, New York Zoological Park.

HENRY FAIRFIELD OSBORN

May 29, 1919

SPECIAL ARTICLES

THE REASON MEAT INCREASES OXIDATION IN THE BODY MORE THAN FAT OR SUGAR

LAVOISIER[1] showed that the ingestion of food increased oxidation in the body. Rubner[2] found that of the food materials, the ingestion of meat increased oxidation most, fat next and sugar least. Several theories have been advanced in attempts to explain how food increases oxidation in the body. The one most generally accepted seems to be the theory, or some modification of the theory, of Voit, who claimed that the presence of increased quantities of food materials augmented the inherent power of the cells to metabolize. We[3] found that the ingestion of food produced an increase in catalase, an enzyme possessing the property of liberating oxygen from hydrogen peroxide, by stimulating the alimentary glands, particularly the liver, to an increased output of this enzyme, and that the ingestion of meat, in keeping with its greater stimulating effect on heat production, increased catalase more than fat or sugar. It was found that the amino acids, the essential constituents of meat or protein, were responsible for the stimulating effect of the proteins, the simple sugars for the stimulating effect of the starchy foods and the neutral fats for the stimulating effect of the fats. We found, also, that by whatever means oxidation was increased in the body, there resulted a corresponding increase in catalase. Hence, the conclusion was drawn that the increase in oxidation following the ingestion of food, as well as the increase in oxidation produced in other ways, was due to an increase in catalase.

TABLE I

Material Used	Protein Constituents			Fat Constituents			Sugar
	Glycocoll	Sodium Acetate	Acetamid	Olein	Glycerine	Potassium Oleate	Dextrose
Percentage increase in catalase	56	36	48	40	43	31	24

The object of the present investigation was to determine why the amino acids, the essential constituents of protein, stimulate the alimentary glands, particularly the liver, to a greater increase in catalase, with resulting greater increase in oxidation, than does fat, and why fat produces a greater increase than sugar. The animals used were dogs. The amino acid, glycocoll, and two related compounds, acetamid and sodium acetate; the fat, olein and its constituents, glycerine and oleic acid; and the sugar, dextrose, were the materials used. Ten grams of the sugar and of the amino acid and five grams of the fat, per kilo of body weight, were used.

After etherizing the animals, an incision in the abdominal wall was made and the material to be used was introduced in about equal quantities, into the stomach and upper part of the small intestine, by means of a hypodermic syringe. The catalase in 0.5 c.c. of blood taken from the liver was determined before as well as at intervals after the introduction

[1] Lavoisier, *Mem. de l'Acad. des Sc.*, 1780.

[2] Rubner, "Energiegesetze," 322.

[3] Burge and Neill, *The American Journal of Physiology*, Vol. 46, No. 2, May, 1918.

of the material into the stomach and intestine. The determinations were made by adding 0.5 c.c. of blood to 50 c.c. of diluted hydrogen peroxide in a bottle at approximately 22° C. and the amount of oxygen gas liberated in ten minutes was taken as a measure of the amount of catalase in the 0.5 c.c. of blood.

The maximum increase produced in the blood of the liver by the different materials is given in Table 1. It may be seen that the amino acid, glycocoll, produced 56 per cent. increase in catalase, sodium acetate 36 per cent. and acetamid 48 per cent. increase. By comparing the formulæ of these three substances it may be seen that all three are derived from acetic acid; the amino acid, glycocoll, CH_2NH_2COOH, and acetamid, CH_3CONH_2, being acetic acid, CH_3COOH, with an amino (NH_2) group introduced into the molecule while sodium acetate, CH_3COONA, has the element sodium introduced, hence the conclusion was drawn that the introduction of the amino (NH_2) group into the molecule of the organic acid, acetic, thus forming the amino acid, glycocoll, as well as acetamid, was to increase the effectiveness of the acetic acid molecule in stimulating the liver to an increased production of catalase with resulting increase in oxidation. If the introduction of the amino (NH_2) group into the other organic acids, propionic, valerianic, caproic, succinic and glutaric, thus forming the amino acids, the essential constituents of protein, increases the effectiveness of these acids in stimulating the liver to an increase output of catalase, this may explain the great increase in heat production after the ingestion of protein.

It may be seen further in Table 1, that the introduction of olein, a fat, into the alimentary tract produced 40 per cent. increase in the catalase of the blood of the liver, glycerine 43 per cent., and potassium oleate 31 per cent. increase. By comparing these figures it may be seen that glycerine produced a greater increase in catalase than did the olein and that potassium oleate produced a smaller increase. By comparing the formulæ of these substances it will be seen that the fat, olein, $(C_{17}H_{33}COO)_3C_3H_5$, has in its molecule a part of the glycerine, $C_3H_5\ (OH)_3$, molecule and a part of the oleic acid, $C_{17}H_{33}COOH$, molecule. Since oleic acid or potassium oleate produces a smaller increase in catalase than the olein, and glycerine a larger increase, it follows that the effect of the glycerine radical in the olein molecule was to increase the effectiveness of the fat in producing an increase in catalase in a manner similar to but not so extensive as did the amino (NH_2) group in the amino acids. It may be seen that the sugar, dextrose, produced a smaller increase in catalase than any of the other substances in keeping with the fact that the ingestion of sugar produces a smaller increase in oxidation than fat or protein.

Evidence is presented in this paper to show that the increased heat production following the ingestion of food is due to the stimulation of the liver to an increased output of catalase, the enzyme bringing about the oxidation and that meat or protein, in keeping with its greater stimulating effect on heat production, produces the greatest increase in catalase, fat next and sugar least. The amino (NH_2) group in the protein molecule renders protein, or meat, a more effective stimulant on catalase production and hence on heat production than fat and the glycerine radical in the fat molecule renders fat more effective than sugar.

W. E. BURGE

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. II

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. S. Miner, *Chairman*

H. E. Howe, *Secretary*

Symposium on Library Service in Industrial Laboratories

The public library in the service of the chemist: ELWOOD H. MCCLELLAND, Technology Librarian, Carnegie Library of Pittsburgh. The function of the public library is to serve its public by affording information relating to the problems of the

entire community, and since the field of modern chemistry is now so extensive as to find application in almost every line of human endeavor, it is inevitable that the library should have much to offer the chemist. Library service to the chemist should begin *before he becomes a chemist* and should be emphasized during the entire period of his professional education. The professional chemist—especially the man engaged in research or consulting work—can secure valuable assistance from the well-equipped public library. The broader his field, the greater the necessity for using the general library collection to supplement the professional library. The efficacy of the public library is dependent both upon its resources and its "attitude." Satisfactory service to the community assumes the responsibility of maintaining an up-to-date collection; of so administering this collection as to make its resources readily available; of keeping, to some extent, in contact with local technical activities and of keeping thoroughly informed as to the material in his library. Progressive library methods are necessary not only to keep regular readers informed but to bring the library's resources to the attention of professional men and manufacturers who do not habitually use the public library.

Axioms in the use and abuse of special libraries: HELEN R. HOSMER, formerly of General Electric Co. Now with Dr. Geo. W. Crile Laboratory.

Methods employed in the industrial library of Eastman Kodak Company: GERTRUDE REISSMAN. The Kodak Park Library was established in 1912 in compliance with a strongly felt need for a general reference center for all involved in research work and manufacturing problems. On account of the nature of work done here, the main feature of the library is the completeness of photographic literature. It contains about 6,000 volumes and maintains subscriptions of about 200 current periodicals. Articles of interest contained therein are abstracted in a monthly publication, the *Abstract Bulletin.* Articles in foreign languages are translated, if necessary, and if the information which had been asked for can not be supplied from the library's own resources, great efforts are made to obtain it elsewhere.

Relation of the library to industrial laboratories: W. P. CUTTER, The Chemical Catalogue Co., Inc.

Functions of the industrial library—that of Arthur D. Little, Inc., a type: E. D. GREENMAN. In order to keep in touch with chemical literature the chemist finds the frequent use of a library essential. Research investigations are now carried jointly in the library and the laboratory. That the public, college and technical libraries are not sufficiently accessible to quickly supply desired information, has given rise to the development of the industrial library. These libraries serve as storehouses where information is collected, preserved, indexed and distributed. The working functions of an industrial library and its service to the chemist are illustrated by a description of the library of Arthur D. Little, Inc.

The functions of a research library in the dyestuffs industry: JULIAN F. SMITH, National Aniline and Chemical Co., Inc. Research Laboratory. The Schoellkopf Research Library, named in honor of the pioneer American dyestuffs makers, is classified according to the Dewey Decimal System. The plan of administration is patterned after the usage of public and institutional libraries, with modifications as required by special conditions. It consists chiefly of literature on pure and applied chemistry, the former predominating, and on engineering and physics. A wide range of other subjects is represented to a less extent. There are great possibilities open for the research library in service to the industries.

Interior publicity as an aid to the laboratory: S. M. MASSE, National Carbon Co., Inc.

Long distance library service of the New Jersey Zinc Co.: L. A. TAFEL. Object: To extend library service to any member of the organization wherever located. Organization: Relation to technical department, centralization of library resources, establishment of branch libraries at mines and works. Technical information service: Publication and distribution of the library bulletin.

Features of the library of Stone & Webster: G. W. LEE.

Work of the library of The Solvay Process Co.: W. L. NEILL. The collecting of books and journals for this company began more than thirty years ago. Ours is particularly a special library, mainly on chemical subjects, which contains some 1,200 volumes, including bound volumes of the principal English and German chemical journals. It is in constant use by the staff of chemists. It is indexed on the Dewey system, with the usual cards. We have also, as a second part of the library, files of the principal technical journals, both American and foreign. From these we make abstracts, which are printed and sent out to about 100 men in our employ, one half of whom are in the local office and one half in our other works.

We also circulate among the officials here about twenty of the journals, which are carried out and brought in daily after three days' use.

Special library service in The Barrett Company: E. C. BUCK.

Library service in the chemical department and chemical department laboratories of the E. I. du Pont de Nemours & Company: F. I. GALLUP. The paper outlined the du Pont Chemical Department Library organization, covering especially the following points: (1) Informing the librarians of new work to be undertaken, (2) a monthly exchange of accession reports, (3) the monthly abstract, (4) the patent files and patent catalogue, (5) special research catalogue of references, (6) classification and index of information in chemical department reports, (7) bibliographical work, (8) personal.

Symposium on the Future of Certain American-made Chemicals

Some present-day problems of chemical industry: R. F. BACON and W. A. HAMOR.

A possible menace to American chemical independence: W. D. COLLINS. This paper noted a few instances of unsatisfactory deliveries of chemicals and apparatus for regular analytical work. In some lines American-made products are so superior to the foreign supplies that very few analysts would care to use the foreign articles at any price. In other lines there is some doubt as to the inferiority of American products available at the present time. Many buyers of supplies for analytical, industrial and educational laboratories would pay higher prices for satisfactory American products, but may not be willing to sacrifice time and reliability of results by using inferior products if supplies formerly used again become available. It is suggested that the industrial section or the society either appoint a new committee or enlarge the field of some committee already in existence to canvass the situation in regard to the quality of chemicals and apparatus for regular laboratory work. Such a committee, working, should be able to secure cooperation between buyers, sellers and manufacturers which would remove any lingering desire on the part of chemists for foreign-made reagents and apparatus for everyday use in the laboratories of schools, universities and industries.

Quality first to insure increased success of the chemical industry of the United States: JOKICHI TAKAMINE, JR.

Phenol: ALBERT G. PETERKIN.

Cellulose acetate: H. S. MORK.

Unusual organic chemicals: HANS T. CLARKE.

Also W. J. HALE, L. M. TOLMAN, H. A. METZ and General Information Discussion.

General Papers

Tactical uses of smoke (lantern): BYRON C. GOSS.

Chemical work in the canning industry: W. D. BIGELOW.

Corrosion tests on commercial calcium chloride used in automobile anti-freeze solutions (lantern): PAUL RUDNICK. Three proprietary products were tested for their effect on aluminum, copper and cast iron. Polished plates of these metals were immersed in solutions of the concentration directed by the manufacturers. The plates were suspended in pairs of copper and aluminum, copper and cast iron, and aluminum and cast iron, and also a set of all three, by means of copper wire attached to the emergent ends of the respective plates. The tests were continued for thirty days, the loss or gain in weight of the plates being noted every other day. The curves plotted from these results show not only that aluminum is attacked most severely, iron next, and copper least, as would be expected, but also that the rate of corrosion increases sharply on the eighteenth to twentieth day of immersion.

Oxidation in the manufacture of T.N.T.: A. S. EASTMAN. The final stage of the nitration of toluene in the manufacture of T.N.T. is carried out at such a high temperature that there is considerable oxidation of the nitrotoluenes, by the mixed acid. The extent of this oxidation is indicated by the presence of 15 to 20 per cent., of $HNOSO_4$ in the spent acids. This represents the reduction product, and it was desired to identify a corresponding quantity of oxidation products. 2-4-dinitrobenzoic acid was isolated. 1.24 per cent. of the toluene is lost by oxidation to organic acids. The gas evolved during nitration contained CO_2, CO, N_2 and O_2 in quantities sufficient to lower the yield of T.N.T. by 4.9 per cent. This gas varies in composition, but may contain sufficient CO to be explosive, causing the top of a nitrator to be blown off, without detonating the T.N.T.

A new bomb calorimeter for industrial laboratories: W. L. BADGER. The only feature of this bomb that is radically different from other well-

known types is that it is made of Monel metal and is not lined. The sulphuric and nitric acids formed during the combustion of the coal sample attack the bomb very slightly. Gravimetric sulphur determinations give the sulphur correction directly. Since some of the acids are neutralized by the metal of the bomb, the nitric acid correction can not be determined, but is ordinarily too small to affect the accuracy of determinations for industrial purposes. The result is a bomb which gives results agreeing with the standard types much closer than the ordinary errors in sampling and which can be made for a small fraction of the cost of any lined calorimeter.

Non-metallic inclusions in steel: E. G. Mahin. In this paper the origin and nature of inclusions is briefly discussed and the general effects upon the properties of the steel are noted. The principal effects are of two classes: (1) They produce the same kind of weakness as would result from cavities of similar size and form. (2) Ferrite segregation usually occurs in such a manner as that inclusions are found as nuclei of ferrite grains. If the steel is forged or rolled these grains and their inclusions become elongated and ordinary thermal treatment fails to destroy the resulting banded structure. The various theories that have been advanced to account for these facts are discussed, particular attention being devoted to the idea of Stead, to the effect that iron phosphide is entirely responsible for ferrite segregation and that inclusions have a purely incidental connection with this phenomenon. Experimental work is described, illustrated by lantern slides, as a result of which the conclusion is reached that the persistence of ferrite bands is, in fact, largely or entirely due to phosphorus, but that inclusions exert an effect upon the crystallization of ferrite which is independent of the presence of phosphorus. Certain hypotheses are advanced to account for the observed facts.

Mineral rubber: Gustav Egloff.

Manufacture of castor oil: J. H. Shrader. A description of the technology of castor oil manufacture as practised by the castor oil manufacturers, together with that of the government plant at Gainesville.

Possibility of commercial utilization of oil from cherry pits, tomato seed and grape seed: J. H. Shrader. The possibility of the commercial utilization of the canning house by-products of cherry pits, tomato seed and grape pomace is considered in the light of the economic question involved in assembling the raw material before manufacturing the finished product, together with a brief description of the technical questions involved.

Sugar saving by home-grown sugar beets: John M. Ort and James P. Withrow. This work was undertaken as a war help, though interest in the subject in rural communities and state institutions has existed for years. In the ordinary manufacture of beet sugar, the sugar is separated from the syrup by crystallization and the sugar then refined. This leaves most of the salts and strongly flavored organic impurities in the residual impoverished syrup of molasses so that it is fit only for cattle food or fertilizer. It is this material also which has rendered difficult the elimination of the beet flavor from the syrup from sugar beets. Otherwise the making of this syrup for home consumption would long ago have been an important rural home industry. Home cultivated sugar beets properly trimmed, peeled, decored and sliced were found to yield a bright syrup with good taste upon treatment with hot water after a preliminary wash and then boiling down. This gives a sweetening available for many culinary purposes and in which, with ordinary care, the characteristic beet flavor is nearly eliminated or not too prominent for use as syrup. Contrary to the published statements no simple treatment has been found which will consistently render this syrup entirely palatable but it can be used in all cases with as little real basis for objection as the sorghum syrup so much made in rural districts. It is hoped that more resourceful investigators will succeed in the entire elimination of this disagreeable flavor, and in every case. We have but dipped into the subject.

Charles L. Parsons,
Secretary

(To be continued)

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CONTENTS

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GROWTH IN ORGANISMS[1]

THE main proposals discussed in this address were as follows:

1. The development of an organism from the spore or embryonic stage includes the two processes of auxesis or enlargement and of differentiation both in the single cells or elements and in the organs.

2. The present studies are based upon the conception that living matter is composed mainly of pentosans and albumins or albumin derivatives with lipins as a minor component. The proportion of the main components may vary from nearly a hundred per cent. to nearly zero.

3. The principal and characteristic substances of the two groups are practically non-diffusible and hence come together only as an intimate mixture in a colloidal condition, with varying arrangement.

4. Growth of living matter consists of hydration with accompanying swelling and of accretion of solid matter, the two processes being actually independent.

5. The hydration of the substances belonging to the two main components is affected in an opposite manner by hydrogen ions, and is variously modified by temperature and other conditions: the rate and amount of growth is a resultant of several reactions.

6. Accretions of new material include the absorption of salts which tend to restrict hydration and the incorporation of amino-compounds. So-called nutrient salts do not constitute food but may act as catalysts or releasers of energy in other substances and as controls.

7. The enlargement of cells is almost entirely by the swelling which results from hy-

[1] Presidential address, Pacific Division of the American Association for the Advancement of Science meeting at Pasadena, June 19, 1919. Manuscript abbreviated by the author.

dration in their earlier stages, and later the enlargement of the syneretic cavities in the colloidal structure is followed by the distending or stretching action of osmostic pressures in the vacuoles thus formed.

8. Illustrations by records of growth of leafy stems, joints of cacti, fruits of *Solanum* and trunks of trees.

The development of an organism from the single- or few-celled stage to the stature of the adult individual is generally characterized as growth. One of the first facts that comes to the notice of the observer who follows the life history of an animal or plant from the egg or the spore or from the resting stage in a seed to maturity is that all parts of the individual do not enlarge at the same rate, and that if attention be fixed upon the most readily available object for such a study, the root or shoot of any plant, it will be seen that the power of expansion seems to reside only in the region of the tip in the case of the root and in the tip and in certain regions in the younger internodes of stems, while such organs as the leaves of grass elongate by the action of a growing zone at the bases. There are of course many specializations of this action such as those displayed by simple organisms in which a single cell is the inidvidual and when this reaches full size all possible growth is accomplished. As our principal purpose in the present discussion is to present the action of the protoplasm in growth it has been found most convenient to use facts discovered by the measurement and analyses of plants consisting of many millions of cells.

With magnifications of much less than a hundred, we readily see that the embryonic cells of a plant which may be imagined as of a cubical or prismatic form and consisting of a dense mass of colloidal matter, become larger, that they also change form, show new structures in the mass and that the enclosing wall takes on a variety of forms. These changes determine the final part which the maturing cell may play in the complex processes of the organism. The architecture of the plant includes many beautiful mechanical designs and it would be well to guard against the error of considering it as simply a set of sacs, test tubes, and bits of jelly by recalling the fact that it is, like all living things, an engine which not only picks up its fuel, manufactures it into briquettes, or their physiological equivalent, burns this fuel, the derived energy being used in a variety of ways, but while this is going on the machine is also adding to, repairing and altering its own parts. This, however, does not imply that any special or mysterious "life forces" are concerned. The physiologist may in fact identify a large number of the things that may happen in the cell and he may imitate many of them and the progress of science will be marked by the successive subjugation of others, but to assemble the material in a way to obtain the complexity and the sequences of reactions of living matter is beyond our capacity for manipulation, and our failure may not be ascribed to the lack of any elusive vital spark.

The taste for polysyllabic definitions of protoplasm has waned and we are not so much concerned with inclusive descriptions as with an understanding of the nature of the substances which enter into its composition and how these react when subjected to conditions which may prevail in the cell. Protoplasm when viewed with a low power microscope appears to be a silvery translucent mass of material like a highly hydrated jelly, which, in fact it really is, being composed of about one to two parts of solid matter to about two hundred of water. The constituency of the solid part, or the residue which is obtained by driving off all of the water is a matter of no little interest, since it is upon this physical basis that all of the properties of the organism rest.

The proteins or albumins are invariably present, and the transformations in the highly complex molecules of the nitrogenous compounds in living matter offer some tremendous difficulties in interpretation and at the same time yield the material for some of the most romantic chapters in biological science. Present in every cell, these substances may not move from one protoplast to another ex-

cept in the highly hydrated state known as peptones, or when broken apart into comparatively simple amino-compounds. Gelatine, a substance of an albuminous character, has been widely used in experimental work which had for its purpose the determination of the properties of living matter, but we are now so far advanced as to know that it may represent the qualities of the protoplast only in so far as these may be identical with amphoteric compounds. In other words, the behavior of gelatine may be used to some extent to simulate the reactions of protoplasm which consists largely of albuminous substances. This is not a universal condition and in fact is the exception in plants.

Lipins or fatty substances form an important part of the living matter of animals and in their growing cells may constitute as much as two per cent. of the solid matter, amounting to one part in a thousand of the total weight. The lipins may unite with phosphoric acid, with carbohydrates, or with nitrogenous substances such as the amino-acids; giving diverse materials, the action of which in the life processes is but dimly comprehended.

The physiologist who devotes himself to the study of life as exemplified by animal forms deals with a protoplasm in which the proteins and lipins predominate, and is excusably apt to believe in the universality of the properties he uncovers by a study of their reactions. The presence of mucin, gums and mucilages in living matter has long been known, but the determination of their definite occurrence as a component part of the mechanism of the cell was first acomplished at the Desert Laboratory. Numerous analyses show that the pentoses and their condensation products the pentosans are abundant in plant cells, and that they may form a larger proportion of its dry weight than do the proteins or nitrogenous substances.

Here however, we must avoid the mistakes of our predecessors by assuming a universal condition. Specialized organs or cells, eggs, spores, pollen cells, etc., may have a protoplasm in which the protein material may make up almost the entire solid matter, and at the same time it is not to be assumed that the main components are evenly distributed throughout the mass of the protoplast, as it is very well known that the nucleus and other special organs of the cell are high in albumins. Consultation of available information on this point shows that in bacteria for example over 90 per cent. of the solid matter may be albuminous. The analyses of cacti made by Dr. H. A. Spoehr at the Desert Laboratory show that not more than a tenth of the living matter is proteinaceous, and that the greater part of the cell content is carbohydrate, pentosans, of which gum arabic, tragacanth, mucilage and agar are common examples, these being in fact combinations of the simpler pentose and hexose sugars.

Miss Stewart of Barnard College has recently described the manner in which pentosans formed in the cytoplasm accumulate in a layer next the wall leading some observers to believe mistakenly that they were formd by the hydrolysis of wall material. In other cases masses were formed in cavities in the protoplasm. Gross chemical analyses determine the presence of such substances in material in which they occur only in finely divided form in the colloidal mixture and may not be detected by microchemical methods. At present our knowledge of these substances is confined chiefly to their action as a part of the hydration or growth mechanism, and it is by no means clear that they are not more or less included in the metabolic cycle.

These statements are not to be taken as implying a simple composition for protoplasm: The different and various pentosans on the one hand and the amino-compounds built up by the plant or derived from albumins have various special characters although the first agree in being weak acids, and the second are amphoteric, capable of acting as either acids or bases according to conditions. As an example of these differences there has been much discussion as to whether or not protoplasm was soluble or miscible in water. It is obvious that living matter in which the pentosan was a mucilage like gum arabic would be miscible with water, while a pentosan like

tragacanth would be less soluble, and a group like agar, for example, would not appear to be soluble at all. It is by no means implied that solubility invariably depends upon differences in the carbohydrate component as it might also result from the character of the amino-compounds or proteins present, expecially in a protoplasm rich in nitrogen.

My studies of growth have been carried out on the assumption that the principal features of importance are those which might be due to the reactions of the carbohydrates and of the proteins which may be present. It is in order therefore to inquire into the condition in which these substances may occur in living matter particularly with respect to their relation to each other. The first and most important relation to be considered is the fact that the mucilages or pentosans and the albumins of amino-compounds of the cell may diffuse into each other very slowly or not at all. Their joint presence in living matter is in a condition in which they are intimately mixed in a colloidal condition. Molecules or groups of molecules of each lie side by side with various possible arrangements. Thus it is conceivable that the mucilage of a cell might be in the form of a mesh or honeycomb with the proteins forming droplets enclosed in the continuous structure, or the reverse might be the case; again substances of both groups might each form a continuous meshwork interlocking with the other, and another category of variables would be introduced by the lipins which might be interposed or incorporated in these systems. Living matter probably does not remain fixed in any one of these simple arrangements, or in any one of a dozen others which might be described if space permitted, and the suggestion is ventured that the play of molecular force where aggregates of a different kind are in contact may constitute the essential and characteristic action of living matter.

Let us now fasten attention upon the theoretical final structure of protoplasm and endeavor to construct for ourselves a mode or plan of action which might be followed in its growth. Growth as has been defined consists of two processes. First the molecules or aggregates of molecules of the two kinds, the carbohydrates and the albumins, combine with and absorb water, thus increasing the volume of these units regardless of whether such molecules be in the form of droplets or fibrillæ of a meshwork. Instances of growth are known in which water only has been added to the colloidal structure in which in all probability the solid particles have been variously rearranged. In general however growth is accompanied by the accretion of molecules of solid material in such manner that as development proceeds their proportion to that of the water taken increases and organs are then said to show an increase of relative dry weight with age.

On the other hand, my own studies have shown that succulent organs or stems, such as leaves of the Crassulaceæ, joints of cacti, fruits, etc., do not show such increase and the proportion of solid matter and of water undergo but little change, their incorporation being at a rate which keeps them near the initial proportion. It is suggested that such action may be shown by the fleshy fungi although I have not seen any data bearing directly upon this matter.

The conditions under which hydration may ensue are by no means identical for the two main constituents of living matter. Thus the albumins and their derivatives as exemplified by the behavior of gelatine show a swelling determined or facilitated by the hydrogen ion concentration or acidity of the solutions, being increased as this rises. The pentosans, on the other hand, show no such increase, and being weak acids, their hydration is retarded by the hydrogen ion. The swelling of a mixture of the two will therefore be a resultant of these effects and of the proportion of the two elements in the living mixture, and as the unceasing action of respiratory metabolism results in the formation of some residues of acids, the condition of hydration of any mass of protoplasm may be said to reach a volume determined by these opposed reactions. The effects in question may be illustrated by the citation of my experiments, in which gelatine

was found to show a swelling in hundredth normal acetic acid fifty per cent. greater than in distilled water, agar forty per cent. less, and a combination of eight parts of agar and two parts of albumin, about forty per cent. less than in water.

The hydrogen ion concentration of the fluids in a plant cell are controlled by the buffer conditions which exist there, but still the range of variation is much wider than that found in the circulatory systems of animals. Bases or cations are seen to affect the swelling of the plasmatic mixtures in my experiments. Various authors having secured results indicative of accelerating effects of certain amino-compounds on growth, some swelling tests of the effects of these substances were made with the discovery that such an amino-acid as glycocoll in hundredth molar solutions seems to retard the swelling of gelatine, at least when the increase in thin dried plates is considered, and to accelerate the swelling of agar to and beyond the total in water. The mixture of agar and albumin, as well as a mixture of agar and gelatine, shows a greater hydration in glycocoll than in water.

The possible physiological significance of these results is heightened by the knowledge of the fact that some of these amino-compounds may be taken to be universally present in growing cells and they probably vary less than the organic acids. It is suggested that the ammonia group in these compounds may form a salt with the carbohydrates with the effect of increasing the hydration capacity. Whether any reaction with, or effect upon, the hydration of the protein element occurs is not yet clear, although it is obvious that such action might be of fundamental importance in nutritive metabolism. The entire matter of hydration may be briefly summarized by the statement that the fundamental properties of a colloidal mixture or of living matter will depend upon the proportion of albumins and of pentosans, and upon the properties of the particular substances of each group which may be present. Hydrogen ions within the possible range of concentration increases hydration of the albuminous substances and depress that of the pentosans. Bases or cations exert a reverse effect on the albuminous substances and depress hydration of the pentosans slightly. Certain amino-compounds depress the swelling of albuminous compounds, but facilitate the hydration of pentosans and sections of such substances when mixed in a proportion of four to one with albumin undergo hydration to a degree equivalent to or even greater than that in water.

The second phase of growth, that of the incorporation of molecules of solid matter is not so easily described since it is not so directly susceptible of experimental test. If the conception of the pentosan-albumin composition of protoplasm is correct, it is obvious that the mass of living matter may not be increased simply by the addition or diffusion of sugars into the meshwork, as is supposed by some writers.

Before the material in these carbohydrates may actually become a part of the colloidal living mesh it is undoubtedly broken down to some extent by enzymatic or respiratory action, part of the material being carried through transformations to organic acids or carbon dioxide, some of the material is combined with the ammonia group (NH_2) to form amino-compounds, some with the lipins, while some of these sugars may be converted to the pentose form in which they would so markedly affect the hydration capacity of the mass.

By way of crude illustration, protoplasm might be regarded as the wick of a lamp which draws sugar into its meshes, burns the sugar and in the burning some of the sugar not completely consumed unites with other substances to form additional fibers of the wick.

At this point it would be well to divert attention for the moment to the so-called "nutrient" salts, the presence of which in the soil and in the liquids of the plant is so indispensable to the plant. It is necessary for an understanding of the real nature of growth to have clearly in mind that living matter is a colloidal mixture of proteins and carbohydrates, which takes up water and gains solid material in growth by processes which are actually retarded by these salts. These com-

pounds in fact yield no energy and furnish no building material. They may act as catalyzers or as releasing agents, and as controls of water absorption or as guides in colloidal arrangement, but they are not "food-material" in any sense. The constituents of fertilizers should be designated as "culture salts" and as such have all of the importance which has been imputed to them; a determination of the composition and proportion of salts in a culture solution which will induce maximum production of grain, fruit or forage is a problem of the first rank now happily receiving something like an adequate investigation.

The foregoing suffices to account for the mechanics of growth or expansion of a single-celled or naked organism. The development of complex, massive or higher organisms especially in plants, however, is accompanied by the formation or deposition of an outer layer of denser consistency which occurs at any phase boundary of colloidal material. This membrane so-called is in any case a product of the surface energy of the mass or system of living material in the cell and of the material in contact and its constitution, and even its structure must vary as widely as that of the protoplasm which produces it.

External to the membrane is the cell-wall which begins to be formed around plant cells as soon as they divide or are separated and this wall increases in rigidity and offers greater resistance to stretching as it grows older.

The arrangement in question, therefore, is one in which the expanding and growing protoplast is enclosed in a sac or bag of its own making and which acts as a screen not only in allowing some materials to pass while others are shut out, but also is so constructed that some solutions pass through it more readily into the cell than out of it, these being simply examples of some of the many facts discussed under the designation of permeability. The external screening membrane takes on a special significance in connection with the osmotic action of the vacuoles.

These sacs were at one time thought to have a morphological value, but it is now understood that almost any hydrating colloidal mass may exhibit syneresis in which cavities or canals are formed in which the colloidal material accumulates in an attenuated or liquid condition. These syneretic cavities increase by absorption of water and by the time the protoplasm of the cell has attained about half of its ultimate bulk in some instances, these cavities have enlarged to occupy a space as large as the protoplasm and acting as vacuoles by which they are ordinarily known, eventually fill a much larger space. The expansion of these vacuoles and the consequent increase in volume of the cell constitutes part of the enlarging action of growth, and this expansion takes place by the force of osmotic action. and the result of such stretching is to set up a tension ordinarily designated as turgidity. The vacuoles continue to hold some of the colloidal material and may also carry in solution almost any substance in the cell which may be passed into them by osmosis or diffusion, including sugars, salts, acids, amino-compounds, etc.

The enlargement of the individual masses of living cells in organisms entails a certain amount of work which in the earlier stages is derived almost entirely from imbibition or adsorption, and while such action continues throughout the growth or life of the living matter, there is in addition the stretching action exerted by the expanding vacuoles by osmotic action. The growing regions or plants at all times include cells in all of these stages, from the newly separated protoplasm which is expanding entirely by imbibition of water and incorporation of new material, others in which the syneretically formed vacuoles are increasing and thus adding to the volume of the cell by osmotic action, and others approaching maturity in which the vacuole may have attained such size as to occupy many times the space of the living matter which may indeed now be but a sac with its layers of irregular thickness lying internal to the wall, which now has become dense and rigid.

The measurement of the growth of a stem, root or fruit of a plant will, therefore, show the composite changes in volume of cell masses

in all of these stages, and consequently express the action of imbibition and osmosis.

The distinct action of imbibition and the later joint action of hydration by osmosis and by imbibition may be most readily recognized, in organs in which the region of growth is generalized as in the ovate flattened joints of *Opuntia* or in such globular fruits as the tomato. The measurement of the growth of one of these joints may be begun when it has a lateral area no larger than the thumbnail, and during this stage the increase is rapid and shows a minimum disturbance from changes in external conditions, as shown by the illustrations. Growth continues throughout the entire mass until an advanced stage of development is reached, when it first slackens in the basal portion. By this time large vacuoles have been formed in the thin-walled cells, and water loss from the surfaces of the organ has reached such a rate that great daily variation in the volume results and actual shrinkage may ensue. A similar history may be predicated for such structures as the large berry-like fruit of the tomato, it being noted that the material in both illustrations takes on solid matter and water at such rate that not much alteration in their proportions occurs during development.

The enlargement of the trunk of a tree results from the multiplication and growth of cambium and other cells on the outside of the trunk directly inside and covered by the bark. The trunk of the tree is in effect a cylinder of moist but dead woody tissue surrounded by a living sheath which becomes very active at some time in the year and which as a result forms an additional layer or sheet of wood on the trunk which in cross section gives the appearance which has caused it to be designated as an annual ring of growth.

The actual course of growth or formation of these annual cylinders or, more strictly speaking, cones, has not until recently been measured. In 1918 I was successful in making a working model of a dendrograph which might be attached to the trunk of a tree in such manner that its changes in volume due to whatever causes were traced on a ruled sheet of paper carried by a revolving drum. The essential part of this apparatus is a yoke of metal, which has two bearing screws resting on the trunk and carrying a third contact point on the end of the pen lever. It was not possible to make a practicable instrument until a yoke could be constructed which showed but little variation as a result of changes in temperature. Three alloys with a very low temperature coefficient, bario C., manganin and invar have been used and dendrographs are now in operation on the trunks of two species of pine, and oak, an ash, a sycamore and a beech tree, and as these instruments were placed in position before growth began in 1919, there is every prospect that seasonal records will be obtained from which the principal features of growth may be seen. Weekly records show that these trees do not behave alike and that many conditions are to be considered in interpreting the records.

It is evident for example that but little is known concerning the properties of bark as a water-proofing or protecting coat for the tree. The loose bark of the ash and pine trees seems to allow such a great water loss from the surface during the mid-day period as to cause actual shrinkage which does not occur in trees such as the beech and live-oak, which have a perfect living green outer bark or skin. The facts disclosed by these records can not fail to be of interest in a discussion of any phase of the complicated problem of the ascent of sap.

D. T. MACDOUGAL
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JOSEPH BARRELL

AMERICAN geology has lost one of its foremost leaders, one who promised to stand as high as the highest. Professor Barrell's other colleagues will undoubtedly agree with Professor T. C. Chamberlin when he says: "We had come to look upon him as one of the most promising leaders in the deeper problems of earth science. We feel that his early departure is a very sad loss to our profession not only, but to the whole group of sciences that center in the earth and its constitution."

Only a few days before his death there came to him the news of the highest honor that can be given to an American scientist, election to the National Academy of Sciences. His election, furthermore, was by a unanimous vote of the academicians present at the April meeting in Washington, and such a vote is rare in the academy.

Joseph Barrell, the son of a farmer, was born at New Providence, N. J., December 15, 1869, and died of pneumonia and spinal meningitis in New Haven on May 4, 1919. He leaves a wife and four sons. Standing 5 feet 10.5 inches in height, of the blue-eyed Nordic type, with a full head of wavy light-brown hair, he was spare and slender in build, but characterized by great muscular strength in comparison to body weight. He was of the eighth American generation from the Puritan George Barrell, who migrated from Suffolk, England, and settled at Boston in 1637. This first American Barrell began as a cooper, but most of his descendants have been sea-going people and shipping merchants. The most widely known and wealthiest was Joseph Barrell of Boston, after whom the subject of our sketch, his great-grandson, was named. This Joseph Barrell is said to have "early espoused and firmly maintained the cause of his country," and for a time represented the town of Boston in the State Legislature. It was in his splendid home that General George Washington was entertained during his visit to Boston.

Professor Barrell received the first part of his collegiate education at Lehigh University, taking in due course its B.S., E.M. and M.S. degrees, and in 1916 this institution gave him its doctorate of science. From 1893 to 1897 he was instructor in mining and metallurgy at his alma mater, and then was given leave of absence to go to Yale for graduate studies in geology, taking his Ph.D. degree in 1900. Returning to Lehigh, he was made assistant professor of geology, and for three years taught not only geology but zoology as well. In 1903 he was called to Yale as assistant professor of geology and in 1908 promoted to the chair in structural geology. In the geological department at Yale he was a unifying force and a tower of strength. During the summer months from 1893 onward, Barrell spent nearly all the time in the field, working at first as an engineer in the coal mines of Pennsylvania, then in the mines of Butte, Montana, devoting one summer to the geology of southern Europe, and later studying widely the geology of the Appalachians and of the New England States.

Professor Barrell's first publications, in 1899 to 1900, deal with mining, but since 1901 nearly all his work has been in geology. His bibliography has upward of forty-five titles, totalling more than 1,500 pages. Several articles remain unpublished, at least two of which it is hoped to print during this year. A more detailed account of his life and work will appear in an autumn number of the *American Journal of Science.*

Barrell's most important work has to do with the strength of the earth's crust. The series of papers bearing that title examine into "the mechanics of the earth considered as a body under stress, owing to the variation in density and form which mark its outer shell." He was all the more able to handle this most difficult subject because of his thorough training in engineering at Lehigh. His last work along this line will be published this fall. From the manuscript we learn that "The larger features of the earth's surface are sustained in solid flotation, and at some depth the strains due to the unequal elevations largely disappear, the elevations being compensated by variations of density within the crust. In consequence, the subcrustal shell is subjected to but little else than hydrostatic pressure." Isostatic balance is, however, not everywhere in adjustment, but the adjustments are held to be irregular and imperfect in distribution and mostly concentrated in the outer one hundredth of the earth's radius, with a tendency to progressively disappear with depth. On the other hand, "the outer crust is very strong, capable of supporting individual mountains, limited mountain ranges, and erosion features of corresponding magnitude."

Barrell also did much toward working out the criteria by which the climates, marine

deltas and geographies of the geologic past may be discerned in the sediments or stratified rocks that make up the greater portion of the geologic record. This work brings out especially the importance in earth history of the ancient formations laid down upon the lands by the fresh waters and the wind, in contradistinction to those deposited by the seas and oceans.

The length of geologic time was another problem that deeply interested Barrell. In his "Rhythms and the Measurements of Geologic Time," he came to the conclusion that through the rhythmic oscillations of the terrestrial processes which the earth has undergone, its age is many times greater than even geologists in general have imagined—in fact, that it is of the order of about 1,500 million years.

A fourth line of research which occupied Barrell was the origin and genesis of the earth, and here he extended in modified form the Chamberlin-Moulton planetesimal hypothesis, *i. e.*, that the planets and their moons arose out of the sun during a time of induced tidal disruption. Some of his best work was to develop along this line, and an extensive manuscript on "The Genesis of the Earth" is ready for publication.

Since 1913, Barrell has on a number of occasions taken opportunity to point out that the supposed Mesozoic peneplain of southern New England was in reality "stairlike or terraced in its character, facing the sea, and bore the marks of ultimate control by marine denudation. These terraces [more than five in number] are now dismantled by erosion except in regions favored by the presence of broadly developed resistant rock structures. . . . All are regarded as younger than the Miocene." With this view, he adds, we get "a suggestion of the geological rapidity of completion of an erosion cycle in a region near the sea and of a sequence of diastrophic rhythms there recorded." Here too there is considerable manuscript that will be published later on.

Finally, the evolutionary problems connected with paleontology claimed his interest, and he has presented evidence to show that fishes probably arose in the early Paleozoic in the fresh waters of the lands, and thence migrated to the seas. Also that lungs developed out of air-bladders in water-breathing animals caught in recurrent epochs of semiaridity. Such great environmental changes brought about the necessity for change from a water habitat to seasonal dry ones, and hence "the piscine fauna which endured these conditions came through profoundly changed." The primitive sharks of Silurian time, having no air-bladder, "were driven to the seas. The fresh-water fishes which remained were ganoids and dipnoans, fishes with air-bladders efficient for the direct use of air." Finally, from crossopterygian ganoids, under the stimulus of the semiaridity of the Devonian, there emerged the amphibians, able to carry forward their activities as terrestrial animals.

Similarly, he held that man was brought to his present high physical and mental state not merely as the "product of time and life," but that he is "peculiarly a child of the earth and is born of her vicissitudes." The changing climates during the Pliocene and Pleistocene, acting upon the vegetation of these times, caused the prevalent forests of Asia, he thinks, to dwindle away, producing "a rigorous natural selection which transformed an ape, largely arboreal and frugivorous in habits, into a powerful, terrestrial, bipedal primate, largely carnivorous in habit, banding together in the struggle for existence, and by that means achieving success in chase and war. The gradual elimination, first of the food of the forests, lastly of the refuge of the trees, through increasing semiaridity, would have been a compelling cause as mandatory as the semiaridity which compelled the emergence of vertebrates from the waters, transforming fishes into amphibians."

CHARLES SCHUCHERT
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SCIENTIFIC EVENTS

THE SOLAR ECLIPSE[1]

TELEGRAMS received by the Astronomer Royal report that at the station at Sobral, in Brazil, occupied by Dr. Crommelin and Mr.

[1] From *Nature.*

Davidson for photographing the field of stars round the sun on the occasion of the total eclipse of the sun last week (May 29), the sky was clear for at least part of totality, and that the program was satisfactorily carried out. The photographs have been developed, and all the stars expected are shown on the plates taken with the astrographic lens, as well as on those taken with a second telescope lent by Father Cortie. The expedition will remain at Sobral until the necessary comparison photographs are taken *in situ*. The message from Professor Eddington at Prince's Island, off the coast of West Africa, which reads "Through cloud, hopeful," may be taken to imply that some success will also be derived from the work of this expedition.

It will be remembered that Professor Eddington and Mr. Cottingham were provided with the 13-inch object-glass of the astrographic telescope of the Oxford University Observatory, whilst the observers in Brazil had the similar object-glass from Greenwich, and that the program of both stations was to take photographs of the stars that surrounded the sun, of which there are at least twelve within 100′ of the sun's center of photographic magnitude ranging from 4.5 to 7.0, for the purpose of testing Einstein's relativity theory of gravitation, and also the hypothesis that gravitation, in the generally accepted sense, acts on light. Photographs that have been taken during the eclipse will be compared with others that have been, or will be, taken of the same stars in the night sky to detect any displacement that may be considered to be due to the presence of the sun in the field.

There is at present no information as to the type of the corona, and apparently few observing parties have been organized to make observations to record this. From a note in the daily press last week, said to emanate from the Yerkes Observatory, it seems not unlikely that a large prominence may have been on the limb of the sun at the time of the eclipse.

It had been announced that the Cordoba Observatory would dispatch an expedition to Brazil, and that possibly Professor Abbot, of the Smithsonian Institution, would proceed to La Paz, Bolivia, where the eclipse happened at sunrise, with coronal cameras and with instruments for measuring the sky radiations by day and night, but it is too early to have heard of any results of such observations. Also it has been announced that Professor D. P. Todd would take photographs of the eclipse from an aeroplane at a height of 10,000 feet from the neighborhood of Monte Video, where the eclipse would only be partial.

REVISTA MATEMATICA HISPANO-AMERICANA

Under the above title a new mathematical periodical began to appear at the beginning of the present year, which may be of some general scientific interest both on account of territory covered by its title and also on account of some of its unique aims. One of these is the publication of corrections of errors found anywhere in the mathematical literature. These corrections are to appear in a special section headed *Glosario Matematico.*

While mathematics is an exact science its literature is by no means free from different types of errors, varying from slight oversights to those relating to matters of fundamental importance. The majority of these errors are readily recognized by the careful reader and need only to be pointed out to be acknowledged; but, as mathematics grades gradually into various inexact sciences—such as philosophy, history and physics—it is clear that a part of its literature relates to the eternal approximations towards an unstable limit and here the question of errors connects up with endless words.

The corrections in the *Revista,* published at Santa Teresa, 8, Madrid, Spain, are supposed to be confined to the former type of errors and these corrections may serve the double purpose of curtailing the repetition of such errors and of pointing out somewhat slippery ground in mathematical fields. It is also of interest to walk securely over ground where experts slipped by overlooking lurking dangers which their slipping caused to change to well-marked pitfalls.

General interest in this new mathematical periodical may perhaps be enlisted by the can-

did manner in which the unfavorable mathematical situation among the Spanish-speaking people is depicted in a short note appearing in the first number of this journal. The comparatively slight contributions made by these people along the line of mathematical research stands in great contrast with the large advances made by the people living immediately north of Spain.

One of the most important steps towards the remedy of an unfortunate public situation is to exhibit the great need of such a remedy. It is hoped that the present journal may be successful in this direction and also in awakening interest in a field which is so fundamental for the further scientific development of the people using the Spanish language. The editor of the journal is J. Rey Pastor.

G. A. Miller

EXPEDITIONS OF THE CALIFORNIA ACADEMY OF SCIENCES

Miss Alice Eastwood, curator of botany, of the California Academy of Sciences, has just returned from a three months' study of the flora of Arizona and New Mexico. Miss Eastwood's special mission was to collect trees and shrubs but chiefly cottonwoods for Professor C. S. Sargent of the Arnold Arboretum in connection with the revision of his Trees of North America. At the same time Miss Eastwood made important additions to the herbarium of the academy.

The academy is undertaking exploration work this summer in lower California. Mr. Joseph R. Slevin, assistant curator of the department of herpetology, sailed on June 14 on the steamer *Alliance* for La Paz, Mexico, with the purpose of investigating the reptiles and amphibians of the cape region of the peninsula. Mr. Slevin is accompanied by Mr. Gordon F. Ferris, instructor in entomology of Stanford University. Mr. Ferris is commissioned by Stanford University to make a special study of the scale insects of the region and will also collect for the departments of entomology and invertebrate zoology of the California Academy of Sciences. This work will be chiefly in the lower third of the peninsula and will require about three months time.

Dr. Roy E. Dickerson, honorary curator of the Department of Invertebrate Paleontology, sailed May 31 with Mrs. Dickerson for Manila, Philippine Islands. Dr. Dickerson will make an investigation of the Phillippine Islands with a view to the location of oil deposits. During Dr. Dickerson's connection with the California Academy of Sciences as curator of the department of invertebrate paleontology important research work was carried on in the geology of the Pacific coast area, which received publication in the *Proceedings* of the academy. These papers are much in demand at present by the commercial interests engaged in oil production.

FOREIGN DELEGATES AND GUESTS AT THE ATLANTIC CITY MEETING OF THE AMERICAN MEDICAL ASSOCIATION

Physicians from fourteen foreign countries were in attendance at the meeting. Apart from Canadians they were as follows:

Lehman, Wilmer S., Lolodorf, Cameroon, W. Africa.
Casier, Baron Ernest, Belgium.
Depage, Antoine, Belgium.
Duesberg, J., Belgium.
Melis, L., Brussels, Belgium.
Nolf, P., Brussels, Belgium.
Sand, Réné, Brussels, Belgium.
Captain Van de Velde, Belgium.
Chutro, Pedro, Buenos Aires.
Lee, S. T., Peking, China.
Leonard, Eliza E., Peking, China.
Ming-Shao, Hsu, China.
Peter, William Wesley, Shanghai, China.
Ting-han, Chang, China.
Almila, E., Havana, Cuba.
Carrera, Julio, Cuba.
Fernandez, Francisco M., Havana, Cuba.
Guiteras, Juan, Cuba.
Martinez, Emilo, Cuba.
Somodevilla, Santiago U., San Luis, Cuba.
Kingman, E. L., Zaruma, Ecuador.
Brown, W. Herbert, Glasgow, Scotland.
Dimsey, Edgar R., British Admiralty.
Groves, Ernest W. Hey, England.
Hurst, Arthur F., England.
Lane, Sir William Arbuthnot, England.
Murphy, Shirley, England.
Newsholme, Sir Arthur, England.
Rose, Frank A., London, England.

Thompson, Sir St. Clair, London, England.
Bégouin, Paul, Bordeaux, France.
Lemaitre, Fernand, France.
Picqué, Robert, Bordeaux, France.
Alexion, Alexander, Greece.
Constas, John, Greece.
Allen, Belle Jane, Baroda, India.
Fletcher, A. G., Taiku, Japan.
Kamaimura, Asajiro, Tokio, Japan.
Kodama, Ryuzo, Japan.
Uchimo, Senichi, Tokio, Japan.
Holst, Peter F., Norway.
Muro, Felipe, Lima, Peru.
Ingvar, Sven, Lund, Sweden.

HONORARY DEGREES AT YALE UNIVERSITY

At the commencement exercises on June 18 Dr. Theodore Salisbury Woolsey, professor of international law, emeritus, in presenting candidates for honorary degrees said as public orator:

MASTER OF ARTS

Orville Wright: The survivor of two brothers who by their mechanical skill, ceaseless experimentation and accumulated knowledge of physics, have led the way in mastering human flight. The inventive genius of Mr. Wright in a brief sixteen years has filled the sky with its creations, has changed the methods of warfare, has captivated the youth of all lands and now ventures to cross the ocean.

Samuel Hosea Wadhams: A graduate of Sheffield, in 1894, a surgeon in the regular army, serving in the Spanish War, early sent to France as an observer, placed later on the General Staff, in tact, in vision, in ability preeminent, Colonel Wadhams, more than any one else, has shaped the policy of his department. During our share in the war, he has borne the entire responsibility for the wounded in the battle area, has won the admiration of his fellow workers and has earned the honor which his university desires to pay.

DOCTOR OF SCIENCE

Samuel Wesley Stratton: Mathematician, physicist, professor in the Universities of Illinois and Chicago, a naval officer in the Spanish war, since 1901 director of the National Bureau of Standards in weight and measures. Dr. Stratton's work in this bureau has been conspicuous and constructive, recognized beyond our own limits, vitally important in war and war research. A man weighed in the balance and not found wanting.

Harvey Cushing: Son of Yale and Harvard professor, a leader in the new field of neurological surgery, in operations of the brain preeminent, surgeon in chief of the model Brigham Hospital, honored at home and abroad. Colonel Cushing served with the French in 1915 and 1917, with the British at Messines and Passchaendaele, being mentioned in dispatches. At this time organizing intensive study of penetrative skull wounds, he reduced their mortality by one half. Under our own flag he became chief consultant in neurological surgery for the A. E. F. A gentleman, a bold investigator, an artist in the operative field.

SCIENTIFIC NOTES AND NEWS

Princeton University has conferred the doctorate of science on Dr. John M. Clarke, director of the State Museum of New York, and the degree of master of arts on Mr. Lester E. Jones, director of the U. S. Coast and Geodetic Survey.

Dr. David F. Houston, secretary of agriculture, has received the degree of LL.D. from Brown University.

The honorary degree of doctor of science has been conferred upon Dr. Raymond Foss Bacon, director of the Mellon Institute of Industrial Research, by De Pauw University.

On the occasion of the annual commencement of the University of Pittsburgh on June 13, the honorary degree of doctor of engineering was conferred upon Mr. Vannoy H. Manning, director of the United States Bureau of Mines, in recognition of his noteworthy accomplishments in the investigation of problems of mineral technology. The university also conferred the honorary degree of doctor of chemistry upon Dr. Willis R. Whitney, director of the Research Laboratory of the General Electric Company, Schenectady, New York, because of the valuable service which he rendered to the government as a member of the

Naval Consulting Board. These honorary degrees were given upon the recommendation of the Mellon Institute of Industrial Research, an integral part of the University of Pittsburgh.

DURHAM UNIVERSITY has conferred its doctorate of science on Sir E. Rutherford, Sir G. T. Beilby, Professor A. A. Herdman and Professor J. J. Welsh.

SIR J. J. THOMSON has been appointed a member of the advisory council to the committee of the privy council for scientific and industrial research.

DR. GISBERT KAPP is about to resign the professorship of electrical engineering in the University of Birmingham.

PROFESSOR Robert W. Wilson has retired from the chair of astronomy at Harvard University.

THE Royal Society of Arts, London, has awarded its Albert medal for 1919 to Sir Oliver Lodge "in recognition of his work as the pioneer of wireless telegraphy." The medal was instituted in 1864 to reward "distinguished service in promoting arts, manufactures and commerce."

PROFESSOR G. ELLIOT SMITH has been elected president of the Manchester Literary and Philosophic Society.

DR. RAY LYMAN WILBUR, president of Stanford University, who has always taken particular interest in the sociological problems connected with diseases, has been elected president of the California State Conference of Social Agencies.

AT the annual meeting of the Linnean Society on May 24, Dr. A. Smith Woodward, of the British Museum of Natural History, was elected president.

CHARLES W. LENG, secretary of the New York Entomological Society and research associate in the American Museum of Natural History, has been appointed director of the Museum of the Staten Island Institute of Arts and Sciences. Mr. Leng has been interested in the natural history of Staten Island, where he was born and lives, since boyhood. Entomologists and other naturalists, visiting New York City, can reach the museum of the institute by a pleasant half hour's sail across the bay on the Staten Island ferry.

UNIVERSITY AND EDUCATIONAL NEWS

AMONG the gifts announced at the commencement of Harvard University were the following: From the estate of Mrs. Robert D. Evans, \$15,687; one half each to the Arnold Arboretum and the Dental School. The James C. Melvin Fund, anonymous \$53,750 for tropical medicine. Anonymous gift of \$11,250 for the departments of agriculture and landscape architecture. Estate of Mrs. Charles H. Colburn, \$97,052, for the study of tuberculosis. Mrs. Winthrop Sargent, \$27,500, of which \$25,000 goes to the Blue Hill Observatory. From the Nathaniel Canners' Association, \$15,000 for studies in public health.

DR. LEROY S. PALMER, assistant professor of dairy chemistry in the college of agriculture of the University of Missouri, has been appointed associate professor of agricultural biochemistry in the college of agriculture, University of Minnesota, and dairy chemist in the Minnesota Agricultural Experiment Station. George E. Holm, Ph.D., Minnesota, 1919, has been appointed assistant professor of agricultural biochemistry and assistant agricultural biochemist in the Experiment Station. He will devote his time almost exclusively to research on the proteins.

A. F. KIDDER has resigned as professor of agronomy in the college of agriculture of the Louisiana State University to accept the position of agronomist and assistant director of the State Agricultural Experiment Station, Baton Rouge.

DR. ALBERT SCHNEIDER, of the pharmaceutical department of the University of California, will go next September to the University of Nebraska as professor of pharmacognosy and director of the experimental medicinal plant garden.

Professor H. H. Chapman returns to the Yale Forest School to assume his duties as Harriman professor of forest management. He has been assistant district forester, in charge of silviculture at Albuquerque for the past two years.

At the recent commencement the following appointments were made in the department of zoology, college of liberal arts, Syracuse University: Dwight E. Minnich, Ph.D. (Harvard, '17), of Oxford, O., instructor in zoology; Harry S. Pizer, M.Sc., of Brooklyn, N. Y., assistant in zoology.

Dr. Frank A. Hartman, of the department of physiology, the University of Toronto, has been appointed head of the department of physiology at the University of Buffalo.

Colonel J. G. Adami, F.R.S., professor of pathology, McGill University, Montreal, has been elected vice-chancellor of the university in succession to Sir Albert Dale.

Professor Grafton Elliot Smith, professor of anatomy in the University of Manchester, has been appointed to the chair of anatomy at University College, London.

DISCUSSION AND CORRESPONDENCE

TECTONIC FORM OF THE CONTINENTS

Our prevailing notion concerning continental mass is strictly geographic in significance. In our definition tectonics finds no place. Relation of sea and land is made causal and essential; whereas it is only accidental and trivial. The outstanding feature is a broad basin with high mountainous rim and a low sea-level interior. This is a statement of the observation of the late Professor J. D. Dana. In its larger, or telluric, aspects this definition is genetically without meaning.

In the final analysis of the major relief features of our globe the hydrosphere is for simplicity's sake left out of account. The effect then is as if the entire face of the earth were a land area. A condition is premised analogous to that of our waterless moon. Genetically the oceans serve only to obscure the tectonic essentials of relief expression.

Recent experimental reproductions, in spheroidal masses, of those broad basinal tracts that correspond to the oceanic depressions of the geoid are accompanied by results having curious significance. They point to the fact that we shall have to modify our basic conceptions concerning all the major deformations of the earth's crust.

Instead of distinguishing between continental elevations and oceanic depressions, a circumstance imposed by an unweening importance attached to the presence of the sea, a notion handed down from time immemorial, the proper discrimination to be made is between the cordilleran ridges of the continental borders and the intervening lowlands, whether above the level of the waters in the continental interiors, or beneath sea-level in the oceanic areas. On this basis the tracts which we are accustomed to designate the oceanic depressions and the sea-level interiors of the continents are arranged in the same taxonomic category. Consideration of any such datum plane as sea-level may be with full propriety entirely neglected. The meridional disposition of the continents thus comes to be readjusted as relatively narrow orographic ridges in place of broad basin-shaped plateaus.

The tectonic consideration of a waterless earth casts a new light upon the schematic form of our globe. In its logical consequences the contractional hypothesis finds expression in such figments of the imagination as the *reseau pentagonal* of Elie de Beaumont, and the tetrahedral globe of Lothian Green. To be sure the form known as the tetrahedron is of all geometric solids the one form which possesses the least volume in comparison with a given surface area, while the sphere contains the greatest bulk within the same surface; yet the collapse of the latter is not necessarily a crystallographic shape as that indicated by the former.

In the present state of our knowledge any schematic form of our earth is largely conjectural. However, it is suggested lately that in the case of a collapsing spheroid the initial tendency towards a faceted form would prob-

ably not be directly in the line of any limiting shape, as a four-sided figure, but towards something intermediate between a limiting shape and the most general form, or a figure having twelve or twenty-four faces. That the rhombic dodecahedron is possibly the real plan, if there be any, although having in nature curved surfaces, seems to be borne out by the trend of the chief mountain ranges of the world, and by the situation of the main volcanic activities at the sharp solid angles or the points where each set of faces intersect.

Viewed, then, in their telluric relations the continents are probably best regarded not as broad basins with upturned rims but as somewhat irregular, interrupted, meridianally disposed ridges. These ribs appear to be directly traceable in their genesis to released cumulative tension that depends upon the secular retardation of the earth's rotation.

Charles Keyes

AMERICAN ASSISTANCE FOR RUSSIAN EDUCATIONAL INSTITUTIONS

To the Editor of Science: Revolution, war and anarchy threw Russia out of the rut of normal life. And in no phase of Russia's national life have the results been so disastrous as in public education, which can not be placed again on an adequate and normal footing without the assistance of the Allies.

Just before the war, there was adopted a plan for universal education, also for opening a number of higher institutions of learning, especially, technical and agricultural colleges. These educational institutions are open, but on account of complete lack of the supplies needed for conduct of studies and practical work of the students, and, because it has been impossible to obtain apparatus, tools, etc., from Germany and Austria whence they formerly came, it becomes necessary to conduct the studies one-sidedly and incompletely and it is difficult to expect good results from such studies.

There is only one way of obtaining such supplies for Siberia, where several higher institutions of learning have recently been opened, and that is to purchase the supplies in the United States where, at present, most of the laboratory instruments and other technical supplies, so far as I know, are manufactured and are quite satisfactory as to quality.

The writer, who came to this country as the representative of the Ministry of Agriculture, would like to dwell upon this mattter in reference to the laboratories and institutions in different branches of agriculture and experimental stations and also to throw light upon the general aspect of this question.

Equipment of the Russian educational institutions with necessary supplies is furthermore complicated by other circumstances, such as: lack of means and complete impossibility of making purchases for cash owing to very low exchange rate of the rouble at the present time. And, meanwhile, the matter of education is urgent and a way out of this difficult situation is possible only in case the American scientific and academic circles would realize that the problem of education in Russia at present is tragic, if they would have a desire to come to aid and organize such aid.

During the difficult struggle against the Bolsheviki, Siberia had an opportunity to become acquainted with and learned to appreciate the brotherly assistance of the American Red Cross in the matter of organizing hospitals and havens for refugees. The scientific educational matters as well as the work of the Red Cross may and must be outside of politics. It is sufficient to be in sympathy with a people in order to come to their assistance. And, if my American academic colleagues share this point of view and would give an impetus to this new movement in the matter of spiritual aid to Russia, then, I am firmly convinced, the Americans would organize this aid in as splendidly efficient a way as they have organized the Red Cross.

It is, however, self-evident that this aid must be given on an entirely different basis. There could be no question of charity, but simply the matter of facilitating the purchase of the necessary technical equipment by permitting purchases to be paid for in installments.

I do not, by any means, offer my suggestion as the only feasible plan, but would only like

to indicate a plan which, it seems to me, could be realized and would suggest that it would be possible to work along the following lines: Let a competent American scientific-academic organization take up this matter. The writer can make a formal request on behalf of the Russian Ministry of Agriculture and the Ministry of Education. If the organization in question regards the matter favorably, *i. e.*, it decides that it is expedient and necessary to render those portions of Russia which had been freed from the Bolshevik domination, assistance in the purchase of the books, the instruments, the glassware and other technical equipment for institutions of learning, laboratories and experimental stations, let such an organization enter into negotiation with firms who manufacture and supply the American scientific-academic institutions with technical supplies. The purpose of these negotiations would be the arrangement of easy terms of payment on the purchases which would be necessary. Further negotiations could be carried on by an authorized person who has lists of necessary articles and who might be assisted by the Russian Economic League or some other institution which does purchasing of different commodities for Russia. In this way, it will be something like a loan in goods, such loan being made with the spiritual aid of American scientific and academic circles and with certain concessions on the part of the American firms.

It might be mentioned that such concession should prove a very good business investment, since it would be an excellent foundation for substituting American apparatus and tools for the German articles which are the only ones used in Russian schools so far. This concession would be practically an equivalent of advertising American supplies in Russian educational institutions. The very fact of equipping the Russian institutions of learning with American supplies and having the Russian instructors work with the American-made apparatus and tools clears the way for general adoption of American apparatus and tools in Russia. The habit of using a certain kind of apparatus plays a more important part than may be supposed at first sight and it seems that the time is ripe now to introduce in Russia the habit of using the products of American genius and industry.

I hope sincerely, that the suggestion set forth in this letter may be received sympathetically by the American scientists as well as by the special manufacturing and publishing firms which might be concerned with the carrying out of such a plan. I am ready to enter into all necessary negotiations in respect to this matter and I thank in advance any one who will be kind enough to help me with advice or suggestion concerning my efforts in this direction. N. Borodin

Flatiron Building,
Room 1010,
New York City

SCIENTIFIC BOOKS

The Elements of Astronomy. By Charles A. Young. Boston, Ginn & Co. 1919. Pp. x + 508.

Lessons in Astronomy. By Charles A. Young. Boston, Ginn & Co. 1919. Pp. ix + 420.

These are new and revised editions of the most excellent text-books of the late Professor Charles A. Young. From the time this series first appeared some thirty years ago, these books have held high rank among the many that have been written. They show a wide grasp of the fundamentals of astronomy, and these fundamentals are presented to the student in a clear and comprehensive manner.

The author's presentation of the problems involved in the study of the motions of the planets is especially noteworthy. For the mathematician these motions involve the greatest complications and require the most intricate formulas, yet Professor Young places the essential facts before the student in a simple and clear manner. By the aid of a few diagrams and some apt illustrations, the fundamentals of celestial mechanics are explained, and explained so clearly that the youngest student should have no difficulty in understanding the problems and in grasping the essential facts and principles.

The present edition was revised by Miss

Anne S. Young, who retained the greater part of the original text and made such changes only as were necessary to bring it down to date. In general the changes were made with discrimination and the text shows an improvement. Astronomy, however, is not a complete science, and changes and improvements are continually being made. This is especially true of the applications of astronomy to practical matters. In some cases there have been marked improvements in the ideas and methods of thirty years ago, and too rigid an adherence to the original text on the part of Miss Young detracts from the general excellence of the revision. In the discussion of the tides, for example, there has apparently been no change, and the old theory of a world tide, originating in the Pacific and Indian Oceans, has been adhered to. No mention is made of the new theory advanced by the Coast and Geodetic Survey that the tides are purely local phenomena; that the tides of each locality originate in and are confined to that ocean basin of which the particular locality is a part; that the tides of the North Atlantic have no connection with those of the Pacific.

The "Lessons" are for beginners, the "Elements" for the more advanced students. Both books are excellent and no better text-books have yet appeared for these classes of students.

CHARLES LANE POOR

SPECIAL ARTICLES

FURTHER STUDIES IN COLLOID CHEMISTRY AND SOAP

THE following summarizes experimental findings and theoretical deductions which continue studies reported in these pages last year.[1]

I

Our previous work had emphasized not only how from pure soaps and water most typical lyophilic colloid systems may be produced but in what way the chemical constitution of the soaps and variations in concentration, temperature, presence of electrolytes and non-electrolytes, etc., changes the physical properties of these colloid systems. Practically all attempts to explain such changes are to-day electrical in nature. Without denying that electrical phenomena sometimes play a rôle, our newer experiments show that it may be very small or need not function at all.

Typical lyophilic colloid systems may be made of pure soaps in the practical or complete absence of all water. The pure soaps yield such colloid systems with the various absolute alcohols, benzene, toluene, chloroform, carbon tetrachloride and ethyl ether. We feel that our future definitions of lyophilic colloid systems and the understanding of their processes of swelling, gelation, syneresis, reversibility of sol and gel states, hysteresis, etc., must be expressed in the broader terms of mutual solubility. As the hope of getting all phenomena of "solution" reduced to electrical terms seems remote, the hope of getting these fundamental colloid chemical findings reduced to a similar level seems equally remote.

Of the list of effective "solvents," the alcohols have received most study. The solvation capacity of the different soaps (as measured by the maximum amount of alchohol that will be taken up to yield a "dry" or non-syneretic gel at ordinary temperatures) varies in the case of absolute ethyl alcohol for molar equivalents of the sodium soaps of the acetic series of fatty acids from practically zero in the lowermost member to over 27 liters per gram molecule in the case of sodium arachidate. When the solvation capacity of unit weights of any one soap for different alcohols is compared, it is found that this is different not only as mon-, di- or triatomic alcohols are used but different, also, for the different alcohols in any one of the series. For the monatomic alcohols, for example, the solvation capacity increases progressively and smoothly as the position of the alcohol rises in the series. A gram of sodium stearate will just form a gel at room temperature, for example, with 50 c.c. of methyl alcohol, but the same amount of the same soap will form a gel with over 132 c.c. of amyl alcohol. When sodium oleate is the soap employed all the absolute

[1] Martin H. Fischer and Marian O. Hooker, "Ternary Systems and the Behavior of Protoplasm," SCIENCE, 48, 143, 1918.

absorption capacities for the different alcohols lie lower, but their order remains the same

II

If we attempt to say why we obtain these typical colloid systems from such a variety of materials we may begin with the fundamental and now generally accepted conclusion that colloid systems result whenever one material is divided into a second with the degree of subdivision coarser than molecular. A suspension colloid results whenever the colloidally dispersed phase is *not* a solvent for the "dispersing medium"; a hydrophilic or lyophilic colloid whenever the dispersing medium *is* such a solvent (and independently of the fact that the subdivided phase is solid, liquid or gaseous at the temperature employed). When soap is dissolved in acetone and the temperature is lowered the soap falls out as a colloidally dispersed suspension colloid because the acetone is not soluble in the soap; but the same soap dissolved in an alcohol, toluene or carbon tetrachloride, comes out as a lyophilic colloid because these solvents *are* soluble in the precipitating soap.

But the physical characteristics of the ultimately resulting system are not yet explained when we have thus taken into account the mutual solubility characteristics of their phases. In any given case, as with a given soap and its "solvent," four possible results and consequently four main types of ultimate system may be foreseen. At the top exists a non-colloid, "molecular" or "ionized" "solution" of soap (soaped-solvent). For example may be cited a fairly concentrated solution of soap at a higher temperature. At the bottom is found another "solution" but of the solvent in the soap (solvated-soap). Between these extremes exist two main types of mixed systems, namely, one below the top which is a dispersion of solvated-soap in soaped-solvent, and another, above the bottom, which is a dispersion of soaped-solvent in solvated-soap. These are respectively the sols and gels about which we talk. A concentrated solution of soap in any solvent, it will at once be apparent, passes successively, on lowering of the temperature and when not too much solvent is used, from the top of this series through the two middle zones to the bottom.

All the systems below the true solution at the top and above the true solution at the bottom are "colloid." Gel formation is characteristic of the middle zones. Such gels are "dry" anywhere below the point where enough solvated-soap falls out on lowering the temperature to yield a continuous *external* phase enclosing the soaped-solvent. Just above this point they sweat, the amount of such "syneresis" obviously increasing progressively as the amount of solvated-soap becomes inadequate to form a continuous external phase. If the "syneresis" is very great we no longer apply the term, for the syneretic liquid (soaped-solvent) now forms the continuous external phase. The colloid system is said to have remained or to have passed into the "sol" state.

Since change or rate of change in temperature (as well as other factors) affects the solubilities of the two phases in each other unequally it is obvious that the sum total of changes in any system need not be identical *at any given moment and at any given temperature* when the temperature is being approached from a higher level with the sum total of these same changes when the same temperature is being reached from a lower level. The attainment of equilibrium takes time and so the systems hold over the characteristics of the systems from which they came. This is the "hysteresis" of lyophilic colloid systems.

III

The effects of adding different hydroxides and different neutral salts in increasing concentration to standard soap "solutions" has received further study. In order to understand the effects observed and their explanation it is well to divide the experimental findings into three groups while keeping in mind the solubility characteristics of the pure soaps themselves *in* water and *for* water.[2]

1. *Soaps are formed more soluble in the dispersion medium.* The viscosity of the soap mixture regularly *falls.* This happens when

[2] See our previous paper, Martin H. Fischer and Marian O. Hooker, Science, 48, 143, 1918.

ammonium hydroxide is added in any amount whatsoever to a potassium or sodium soap.

2. *Soaps are formed less soluble in the dispersion medium.* This is observed when magnesium, calcium, iron or copper salts are added to a solution of sodium or potassium oleate. The systems as a whole again become more liquid though not in this instance because the soaps are better "dissolved" in the solvent but because they fall out and allow the viscosity of the pure solvent (essentially salt water) to come to the front.

3. *The change in kind of soap is negligible or absent.* This happens, for example, when a neutral potassium salt or potassium hydroxide is added to a potassium soap. Under these circumstances the most interesting of all series of changes are to be noted with increasing concentration of the added material. There is, first, an increase in viscosity which, if the amount of solvent is not too great, results in gelation, followed by a secondary liquefaction and then a progressively increasing separation of soap from the dispersion medium until it finally floats as a dry mass upon the underlying solution of salt or alkali.

If, in explanation, we do not wish to make too many violent assumptions the following seems a reasonable way out. *The fixed alkalies and the various neutral salts are hydrated in water.* As more and more salt is added the number of such hydrated particles (or their size) increases. The effect is two-fold. Through deprivation of solvent the concentration of the soap is increased while the particles of hydrated salt remain emulsified in the hydrated soap.[3] *This emulsification* (with the increase in the concentration of the soap itself) *accounts for the initial increase in viscosity.* As more salt is added the hydrated salt phase attains a value which makes the particles begin to touch. The hydrated soap now becomes the internal phase and the hydrated salt the external one. This change in type of emulsion explains the secondary liquefaction of the gel, a characteristic of these systems not previously noted so far as we are aware. More salt increases further the hydrated salt phase which now begins to separate off at the bottom while the still hydrated soap floats to the top. By adding enough salt all the water is taken from the soap which then floats as a dry layer upon the concentrated salt solution.

[3] Regarding the making and breaking of emulsions, see Martin H. Fischer and Marian O. Hooker, SCIENCE, 43, 468, 1916; "Fats and Fatty Degeneration," 29, New York, 1917.

IV

Various incidental observations upon the reaction of soap-water systems toward indicators of various kinds have proved of importance not only for the theory of these systems but for the understanding of various biological problems, for living matter, too, as so often emphasized, is essentially nothing but a hydrophilic colloid system. The findings show how dangerous it is to assume that physico-chemical methods and opinions (such as hydrogen ion determinations) as derived from the study of the dilute solutions may, without reserve, be applied to living protoplasm.

To be sure of strictly reproducible ground materials we have always prepared our soaps by adding to each other the necessary gram equivalents of fatty acid and alkali. *Any soap as thus formed is either acid, neutral or alkaline to such an indicator as phenolphthalein depending upon the concentration of the water in the system.* Phenolphthalein added to a concentrated sodium oleate solution remains colorless, but this oleate with its contained indicator turns pink or strongly red as more and more water is added to the system. It does not suffice to say that a hydrolysis of the soap is suppressed in the concentrated solution to come to the fore in the dilute solution. It is more reasonable to say that when the water is dissolved in the soap the system is something different from that resulting when the soap is dissolved in the water. If a gel of sodium stearate is used, direct application of phenolphthalein to its fresh section shows the framework of the gel (the water-in-soap portion of the system) to remain uncolored while the soap-in-water portion of the system turns bright red.

A future communication will show how these colloid chemical facts may be used in the erection of secretory models which, like the salivary gland or kidney, yield "secretions" either more alkaline or more acid than the allegedly neutral (or even acid or alkaline) tissues.

It has proved impossible to find an editor with space available for the details of the experiments outlined above and previously reported upon. They must in consequence be brought out in a book. But since the making of such takes time, it has seemed of interest to make a preliminary report upon work which has at various times been lectured upon to different scientific audiences.

MARTIN H. FISCHER
EICHBERG LABORATORY OF PHYSIOLOGY,
UNIVERSITY OF CINCINNATI,
May 5, 1919

THE BUFFALO MEETING OF THE AMERICAN CHEMICAL SOCIETY. III

Testing the mildew resistance of fabrics: F. P. VEITCH and S. S. LEVINE. A method has been devised for testing the mildew resistance of fabrics treated by so-called mildew-proofing processes. The method takes into consideration the important determining mold growth and is conducted in the laboratory under conditions which are highly favorable to the development of mildew and which are carefully controlled. It is briefly described as follows: Six discs about 3.5 inches in diameter are cut from the sample to be tested and soaked in running tap water for two or three days in order to wash out easily removable fungicides and fermentable matter. The damp discs are placed in petri plates containing ten to fifteen cubic centimeters of agar jelly from nutrient matter. The plates are then incubated for seven to ten days in a dark chamber at from 20° C. to 25° C. The condition of the fabric as to the color, extent and character of the growth are observed and recorded. Following this pre-inoculation period the discs are inoculated with pure cultures of several species of molds and reincubated for three weeks to a month and examined each week for mold growth. The observed conditions are rated on a scale of ten. At the conclusion of the tests the discs are washed and preserved as records. The test is a severe one which is borne perfectly for the full period only by canvas treated by the cupra-ammonium process. Its utility has been demonstrated, however, by the fact that canvas which gives a rating of 6 or better has not mildewed on exposure to the weather at Washington, D. C., during the summer and fall months.

Testing materials for increasing the water resistance of sole leather: H. P. HOLMAN and F. P. VEITCH. To determine waterproofing value, several pieces of sole leather which are always of the same tannage and from the same section of the hide but which differ in texture are impregnated by immersing in the treating material for ten minutes at 60° C., followed by warming in an oven at 60° for fifteen minutes. Water absorption is determined by soaking in water for twenty-four hours, with periodical flexing, and weighing the wet leather after removing all excess from the surface. The leather is also weighed before treating, after treating, and in the air dry condition after testing. From these weights the quantity of treating material taken up by the leather, the actual water absorption, and the loss in weight on testing are calculated in percentages. The actual water absorption is calculated on the basis of the final dry weight. All dry weights should be made after exposing the leather to the same atmospheric humidity. Eighty samples, including practically all the commercial materials used in waterproofing sole leather, were tested by this method. Only twenty were found to waterproof sole leather sufficiently to prevent its absorbing an average of more than 35 per cent. of water under the conditions of the test. This percentage was arbitrarily adopted as a limit for satisfactory materials for increasing the water resistance of sole leathers.

Method for determining the water resistance of fabrics: F. P. VEITCH and T. D. JARRELL. In developing more effective methods of making canvas water- and mildew-resistant, and for testing for the War Department deliveries of canvas and clothing for water resistance, it was necessary to employ methods of testing that are both expeditious and indicative of the effectiveness and durability of the treatment. Modifications of the old bag or funnel and of the spray test have been devised which have proved very satisfactory in that all canvas given high ratings by these methods have been found to be water resistant during six months of outdoor exposure throughout the summer and fall. Of the two, the spray test yields possibly the most information. Neither the de-

termination of permeability to water under pressure, nor of water absorption added to the information given by the funnel and spray tests. Fabrics widely different in water resistance showed practically no difference in the quantity of water absorbed in a given time. Details of the methods, including the method of making the exposure tests, illustrations of the equipment and the scale of numerical ratings used, are given in the paper which is to be followed by other dealing with water- and mildew-proofing treatments and with the deterioration caused by such treatments on outdoor exposure.

An impact tester for solid and corrugated fiber board: E. O. REED and F. P. VEITCH. Since the usual methods of testing solid and corrugated fiber board by determining its bursting strength with a Mullen Tester was found unsatisfactory, an impact tester has been devised which closely imitates conditions which fiber board containers must meet in actual service. The results obtained are stated in terms of the height from which a 2-kilogram hammer must be dropped in order to drive a one kilogram plunger, having a spherical base of definite dimensions, through a definite unsupported area of the board. The tester should be useful in establishing impact requirements of different weights of fiber board. Results so far obtained indicate that with this tester data are obtained which are not only a measure of the bursting strength, but also of the resiliency of the board, which are the two main factors determining serviceability.

Waterproof papers for box lining and bale wrapping: F. P. VEITCH and E. O. REED. During the war there has been an increased demand for waterproof papers for box-lining and bale-wrapping purposes due especially to the fact that for overseas shipment, army and navy supplies had to be put in the most compact form and were baled whenever it was possible. Many types of wrapping papers proposed for protecting the contents of bales and boxes against moisture have been subjected to laboratory and actual bailing tests to determine the relative merits of different methods of waterproofing and the probable serviceability of different types of paper as indicated by such test. Very definite information on the most water-resistant types of wrapping paper has been secured.

Lead-coated Iron (exhibits): CHAS. BASKERVILLE. A process for coating sheet iron, iron wire and wire gauze has been worked out depending in part upon dipping the article after the usual pickling and washing into a solution of antimony chloride, thence through a suitable supernatant flux into a bath of molten lead or antimony lead, withdrawing and quenching in oil. Shingles, 10 × 16 ins., of 28 g. iron thus coated, painted and unpainted, have been exposed to the weather in a roof test for two years and eleven months and show 100 per cent. efficiency, that is no rust spots. The shingles may be bent at various angles without cracking the coating and exposing the iron. It is superior to and less expensive than tin plates. Shingles exposed near the exits of sulphuric acid chambers soon show rust, due probably to condensation of nitrous and nitric acids, whose solvent action on lead is well known. Thin sheet iron thus coated is easily pressed into desired shapes, for example, hub caps for motor vehicles, the lead acting as a lubricant. The pressed article lends itself well to nickel plating and subsequent burnishing. Wire gauze (chicken wire), thus lead coated, is quite as good as the galvanized article and cheaper to produce. Heavy steel pipe, 8-inch for pipe lines, was not successfully coated for practical purposes, due to irregularities in the surface and the abrasions produced in the surface and its softer coating, when chains and tongs were applied in screwing the joints together. Where iron in juxtaposition to lead is exposed to aerated water (practical conditions) through incomplete coating (pinholes) or abrasion of the lead, the iron rusts more rapidly as it is electropositive to lead. This is also true for tin-coated iron, while the opposite is true for galvanized iron. However, for some purposes lead-coated metal possesses advantages, especially in expense. Cast iron requires a preliminary pickling in hydrofluoric acid, when it may be coated by the process given, but not perfectly, due to the irregularities of surface. However, this thin coating serves as a satisfactory binding agent for thick layers of lead cast thereon, for example in filter press plates. This was found to be true also for the rough drilled interior of shells; electrolytically deposited lead, with subsequent burnishing, has been found superior for lead coating the interior of gas shells requiring such protection.

Reinforced lead (exhibits): CHAS. BASKERVILLE. Lead in large sheets or heavy pipe flows. Various devices, as numerous straps for sheets, serving as walls in acid chambers, frequently placed supports for pipes, walls of masonry holding sheet lead linings in large petroleum refining tanks, and so forth, are utilized to reduce the sagging.

Vacuum pipes of lead must be of unusual thickness and great weight to prevent collapsing. Iron and steel pipe with lead lining is extensively used, the lead protecting the iron or steel, but the latter also prevents bulging of the lead when the necessary pressure is applied to move the liquids thus transported. These difficulties have been overcome in large part by reinforcing lead with iron or steel gauze in much the same manner that glass is reinforced by wire netting. Wire netting of various sizes of mesh is given a coating of lead or lead-antimony, as described in another paper, and is imbedded in sheet lead of a thickness about one quarter greater than desired, this is then rolled while cold. Reinforced lead in sheets 5 ft. × 6 ins., have been made. They may be bent or cut as desired. Joints have been burned together or finished without leaving any iron exposed. Skeleton frameworks of metal lined with reinforced lead sheeting serve as tanks and other containers without sagging. Eight-inch pipe made of one quarter inch thick reinforced lead withstood a pressure of eight times that of an eight-inch pipe made of seven eighths inch thick lead before collapsing.

Utilization of asphaltic base acid sludge from petroleum: Chas. Baskerville. Instead of cooking the asphaltic base residue with the mixed sulphuric acid to carbonization and then burning the mass mixed with coal as fuel, the present practise, the cooking is carried on at a much lower temperature and for much shorter time. The acid mass separates into three layers, lighter residues being on top, and the heavy sulphuric acid being at the bottom. These are drawn off, leaving the middle portion of asphaltic material containing 15–25 per cent. of sulphuric acid. The proper amount of dry slaked lime is thoroughly mixed with this asphaltic base in a suitable mill. The heat of neutralization is sufficient to fuse the asphalt, which mixed with the calcium sulphate produced, flows into suitable containers, and solidifies on cooling. The mass, which contains 20 to 40 per cent. of calcium sulphate, may be melted and applied where desired, as in the common practise. Time tests have demonstrated the value of the material thus produced for waterproofing (wood and concrete), roofing, road material and as a protective covering for metals. The process is covered by U. S. Patent 1,231,985.

Equilibrium studies on the Bucher process: John B. Ferguson and P. D. V. Manning. A quantitative study of the deleterious effects of carbon monoxide in the furnace gases upon the cyanide conversion at two temperatures, 946° and 1,000° C. The experimental methods employed and results obtained will be presented.

Design for electrically heated bomb for ammonia synthesis (lantern): R. O. E. Davis and H. Bryan. The bomb consists of a nickel-chromium-iron alloy of sufficient strength to withstand several hundred atmospheres pressure. It is electrically heated by a specially devised heater. The method of insulating the walls is shown as are also the method of introducing the catalyst container, and the electric leads.

Purification of compressed gases in testing catalysts for ammonia synthesis (lantern): R. O. E. Davis. The method used in removal of moisture, carbon monoxide, carbon dioxide and oxygen is described and the type of purification chamber used is shown. It is pointed out how necessary it is to have very pure gas in the tests.

Preparation of nitrogen and hydrogen mixture by decomposition of ammonia (lantern): R. O. E. Davis and L. B. Olmstead. A mixture of hydrogen and nitrogen in the proportion of three to one is obtained by decomposing liquid ammonia. This is accomplished by passing the ammonia over heated iron shavings and steel wool. The decomposition is almost complete with the apparatus described, furnishing about 1.3 cu. ft. of gas per minute.

Explosion of gases used in ammonia synthesis: R. O. E. Davis. A description is given of an explosion which occurred in a cotton filter used to remove oil and water spray from mixed nitrogen and hydrogen at a hundred atmospheres pressure.

Some chemical needs of the vegetable oil industry: David Wesson.

Charles L. Parsons,
Secretary

(*To be continued*)

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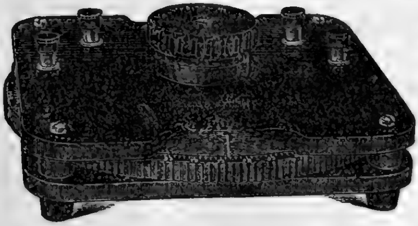

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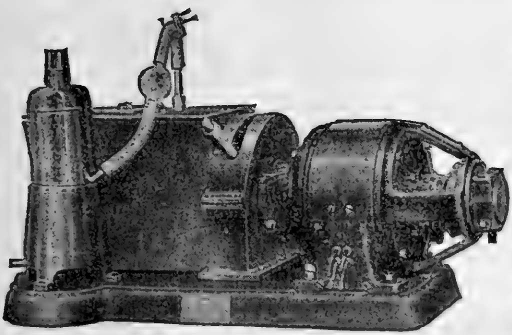

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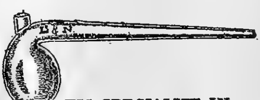

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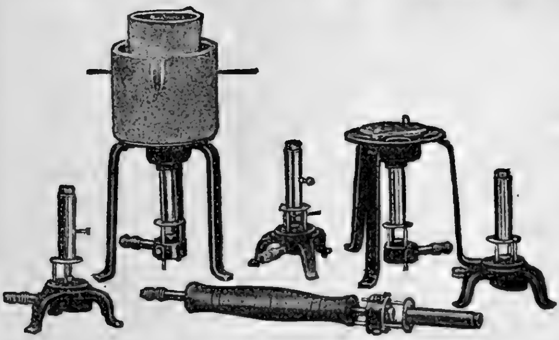

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